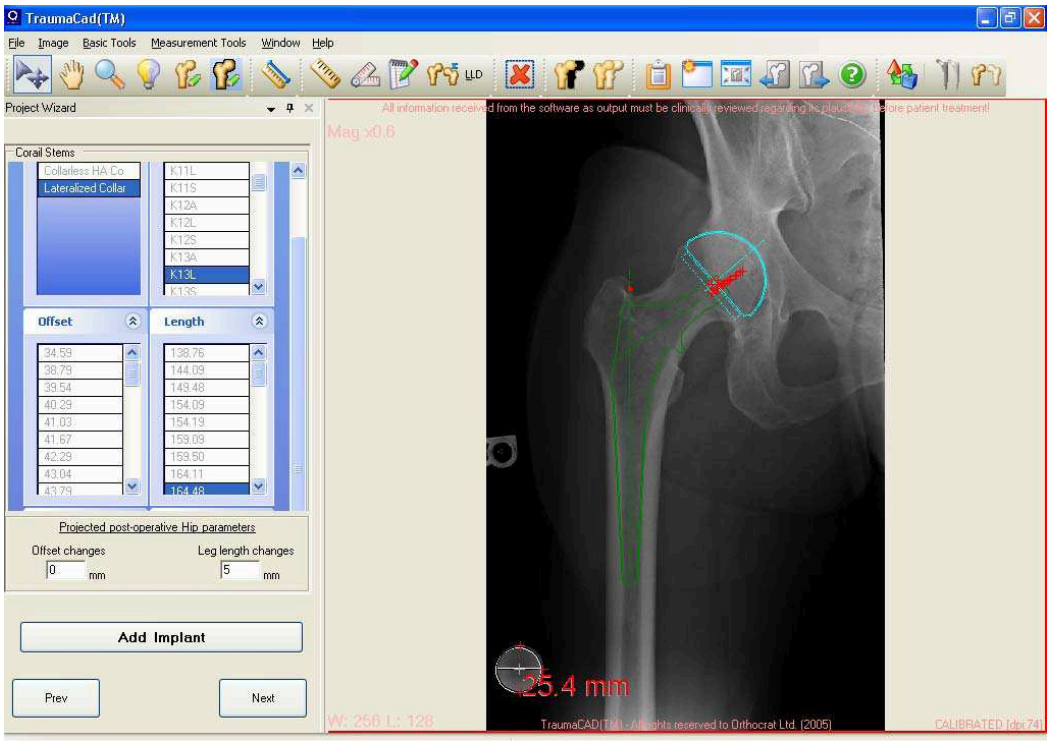
TraumaCad™

User's Guide

Version 1.6



Version 1.6

Important Notice

Copyright and Trademark Notices

Limited License

Orthocrat Ltd, hereby gives license to review these documents solely for non-commercial use within your organization, provided that you do not modify the content of the documents and provided any copies made retain all copyright and other proprietary notices contained therein. The information provided in these documents is permitted solely to users to provide information in support of Orthocrat Ltd products. No other use of the information provided hereunder is authorized.

Nothing contained herein shall be construed as conferring by implication, estoppel or otherwise any license or right under any patent or trademark of Orthocrat Ltd or any third party. Except as expressly provided above, nothing contained herein shall be construed as conferring any license or right under any Orthocrat Ltd or third party copyright.

Limitation of Liability

Information provided on this documents is provided "AS IS" and is provided without warranty of any kind, either express or implied, including, without limitation, warranties of merchantability, fitness for a particular purpose, and non-infringement. Orthocrat Ltd uses reasonable efforts to include accurate and timely information on this web site and periodically updates the information without notice. However, Orthocrat Ltd makes no warranties or representations as to the accuracy or completeness of such information, and Orthocrat Ltd assumes no liability or responsibility for errors or omissions in the content of this documents. Your use of these documents is AT YOUR OWN RISK. Under no circumstances, and under no legal theory or provision shall Orthocrat Ltd be liable to you or any other person for any direct, indirect, special, incidental, exemplary, or consequential damages arising from your access to, or use of, these documents.

Product information is subject to change without notice. Changes, if any, will be incorporated in new editions of publications provided in these documents. Orthocrat Ltd retains the right to make improvements and/or changes in the products and/or the programs described in the publications and information provided on these documents at any time and without prior notice. Mention of non- Orthocrat Ltd products or services is for information purposes only and constitutes neither an endorsement nor a recommendation of such products or services.

Third-Party Information

These documents may contain information of parties other than Orthocrat Ltd. Such information is provided for your convenience and reference only. The said information is not under the control of Orthocrat Ltd, and Orthocrat Ltd is not responsible for the contents of any of such information. The inclusion of this information does not imply any association with their operators or any endorsement of the said third parties by Orthocrat Ltd.

Disclaimer

This software is intended as a decision support system for persons who have received appropriate medical training, and should not be used as a sole basis for making clinical decisions pertaining to patient diagnosis, care, or management. All information derived from the software must be clinically reviewed regarding its plausibility before use in treating patients. Any deviation of the application of medical information from the program, other than the original design or intended use there of, is not advised and considered a misuse of the software product. For additional guidance, see published studies.

CE **0344**

This device complies with the Requirements of the 93/42/EEC Directive Concerning Medical Devices.

Authorized representative address:

CEpartner4U B.V.

Nijverheidsstraat 5

2624 BA Delft

The Netherlands

Phone: +31 15 257 6682

Fax: +31 15 257 6683

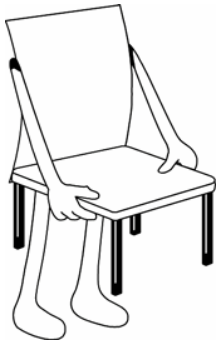
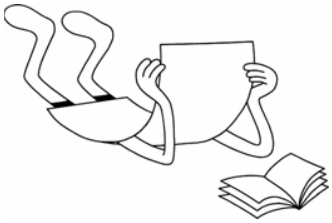


Table of Contents



About This Guide

This guide is intended for surgeons who are performing pre-operative evaluation and planning for orthopedic procedures.

This guide contains the following chapters:

- **Chapter 1, Getting Started with TraumaCad,** page 1, describes the purpose of TraumaCad, its system requirements, how to install it, how to launch it and provides a quick tour through its interface.
- **Chapter 2, Preparing the Image,** page 27, describes how to use TraumaCad to load the required images, specify their anatomical orientation and calibrate the images.
- **Chapter 3, TraumaCad Procedures,** page 45, describes how to use TraumaCad for pre-operative evaluation and planning for a variety of orthopedic procedures.
- **Chapter 4, Measuring Anatomy,** page 69, describes how to use the various tools provided by TraumaCad to measure the anatomy represented in an image.

Contacting Us

US Office
173 S. Portland Ave.
Floor 3
Brooklyn, NY 11217
Telephone (877) 2111-804
Fax (801) 881-5239
Sales@traumacad.com
Support@traumacad.com

Israeli Office
35 Efal St, 12th floor
Petah-Tikva, 49511, Israel
Telephone 972-3-9290929
Fax 972-3-9236413

Safety Symbols

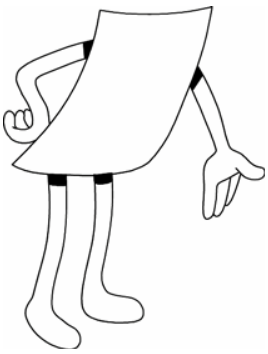
The following symbols are used throughout the documentation. Please pay particular attention at specific points in a procedure when one of the following messages appears.

WARNING!

A WARNING! denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.

NOTE:

Notes provide pertinent information to help obtain optimum performance from the program.



Chapter 1

Getting Started with TraumaCad

What is TraumaCad?

TraumaCad allows surgeons to evaluate and manipulate digital images while performing various pre-operative surgical planning and evaluation of images.

TraumaCad enables increased productivity and improves patient safety. The program features full PACS integration and an extensive regularly updated library of digital templates from the leading manufacturers.

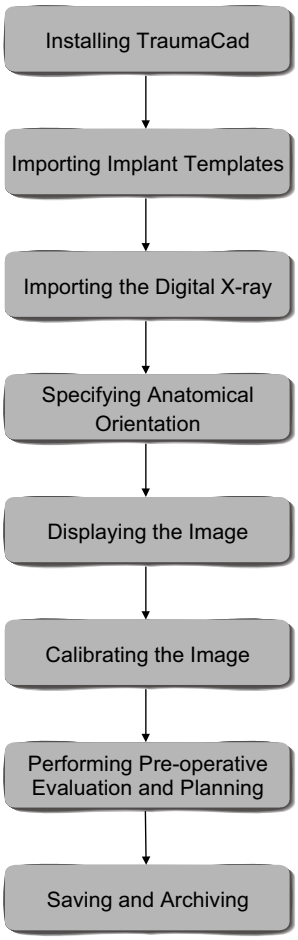
TraumaCad provides easy to use wizards for planning the following procedures:

- Total Joint Replacement: Knee, Hip, Elbow, Shoulder, Ankle
- Trauma
- Pediatric Pelvis Tool

TraumaCad also provides a variety of tools which are especially suited for the measurement of pelvic, knee, spine, pediatric foot and ankle images.

Using TraumaCad

The following provides a chronological overview of the process of using TraumaCad.



Installing TraumaCad

Installation of TraumaCad™ must be performed on a computer that is connected to the Web. TraumaCad can be installed from either a CD or downloaded from Orthocrat's website. For more information, refer to page 2.

NOTE:

For standalone versions of TraumaCad, the PACS Configuration must first be set up in order to specify the connection properties between TraumaCad and the PACS system. Typically, this only needs to be performed once by a system administrator after the initial installation of TraumaCad. The system administrator should make sure to enter the relevant connection properties in the PACS system so that it recognizes TraumaCad. For more information refer to page 22.

Importing Implant Templates

TraumaCad provides a large library of templates, which is loaded and constantly updated — automatically for the server version and manually for the standalone version, as described on page 23.

Importing the Digital X-ray

TraumaCad is transparently integrated with the PACS system and enables full access to its patient images and information. TraumaCad provides a variety of options for finding a specific patient of interest. After you have found the patient, you can select the images in which you are interested. For more information, see the *Loading Images from a PACS* section on page 29.

Specifying Anatomical Orientation

After an image is displayed, whether it was imported from a PACS system or a CD, you must specify its anatomical orientation. For more information, refer to page 34.

Displaying the Image

TraumaCad supports DICOM and enables you to import and export any PACS file (X-ray, CT or MR) from a central PACS system, a CD or from a local workstation. JPG, scanner or digital camera images can also be imported, as described on page 27.

Calibrating the Image

TraumaCad's automatic calibration tool facilitates precise calibration to the actual bone size, as described on page 28.

Performing Pre-operative Evaluation and Planning

TraumaCad provides a simple wizard that will walk you though the process of pre-operation evaluation and planning for surgical procedures, as follows:

- **Joint Replacement Procedures,** page 46
- **Trauma,** page 53
- **Pediatric Pelvis Tool,** page 60

Saving and Archiving

Once the planning of a procedure is completed, a full report is saved, which includes the image, the implants and the measurements that were marked on it. This report is stored in the patient's PACS file, ensuring convenient access.

NOTE:

In addition, TraumaCad provides a series of anatomical measurement tools in manual, semi-automatic and automatic mode. In addition to length, width and diameter, these tools measure leg length discrepancy, Cobb angle, mechanical and anatomic axis measurement, mal-alignment tests and more. These tools can be used on an image at any time. For more information, refer to *Chapter 4, Measuring the Anatomy*, page 69.

TraumaCad also provides a Growth Analysis tool, which provides various options for predicting the growth of a particular anatomy in pediatric orthopedics. For more information, refer to the *Growth Calculator* section on page 83.

Standalone or Client/Server

TraumaCad is installed and runs locally on your computer and interacts with a PACS system. Both a standalone and a client/server version of TraumaCad are available.

The standalone version runs on a specific computer only and stores all its files, such as its configuration and implant templates, on that specific computer.

The client/server version is comprised of a server application that is setup by the administrator, as described in the *TraumaCad™ Server Control Panel Guide*, and client applications that run on specific computers.

These two types of applications operate in a very similar manner and there are only slight differences in functionality, as described below:

Standalone Functionality

All the functionality described in this guide is available in the standalone version.

Client/Server Functionality

All the functionality described in this guide is available in the client/server version except for those listed below. The features that are not available are performed by the administrator. Some of these administrator features apply to all the TraumaCad applications running in an organization, such as the library of implant templates, and some are user-specific according to the user that logs in to a client, as described in the *TraumaCad Administrator's Guide*.

- There is no need to specify the connection properties between TraumaCad and the PACS system because this is performed by the administrator, and therefore the **PACS Configuration** button is not applicable in the client version.
- An organization that runs the client/server version is assigned a certain number of licenses, and the quantity of TraumaCad applications that can run simultaneously (concurrent users) is determined by this license.
- The following are handled by the administrator, and the client does not need to perform them:
  - **Import Image** button in the main window
  - **Import DICOM Folder** button in the main window
  - **Download Template** button in the main window
  - **Screen Capture** option in the *File* menu that captures any image that is displayed on the screen into TraumaCad.
- User specific preferences are defined by the administrator on the server, and therefore the **TraumaCad Settings** button is not applicable for the client version.

System Requirements

Hardware

- 512 MB of RAM
- Processor: P4 1.8 GHZ or higher
- Minimal screen resolution: 1024 x 768
- 40MB free hard disk space and additional disk space for templates

Software

- MS Windows 2000 or later
- MS .Net Framework version 1.1 or higher (this will be installed or upgraded during setup)
- Internet Explorer 6.0 or higher

Clinical Requirements

In order to perform accurate templating, the image should be calibrated. Image requirements may differ according to the image source:

- **Uncalibrated images:** A metal calibration sphere with a known diameter (typically 1 inch) must be placed at the bone level prior to taking the image.
- **DICOM images with a preset calibration attribute acquired from the modality:** There is no need for a physical marker.

Installing TraumaCad

Installation of TraumaCad must be performed on a computer that is connected to the Web. TraumaCad can be installed from either a CD or downloaded from Orthocrat's website at www.ortho-cad.com.

NOTE:
After installation and the first launch, TraumaCad does not need to be connected to the Web.

Installing from a CD

If you are installing from a CD, the following window is displayed automatically:

Click on **TraumaCad time-limited trial version**.

Installing via the Web

If you are installing via the Web, launch Internet Explorer and enter the URL of the organization's server that runs TraumaCad BackOffice. The following window is displayed:

Click **Start Here** and when asked whether to run or save the program, select **Run**. Then, follow the procedure described below.

How to Install TraumaCad

The TraumaCad installation program will check if Windows.Net is installed on your computer. If not, it will download and install it. You are then required to restart your computer. If you are installing from a CD, do not remove it from the drive.

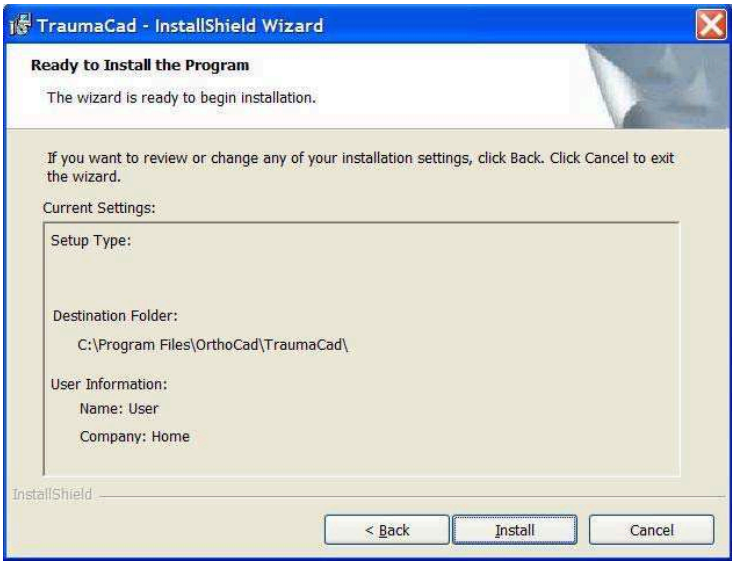
► To install TraumaCad:

1 The **Welcome** window is displayed, as shown below:

Click **Next**. The License Agreement window is displayed, as shown below:

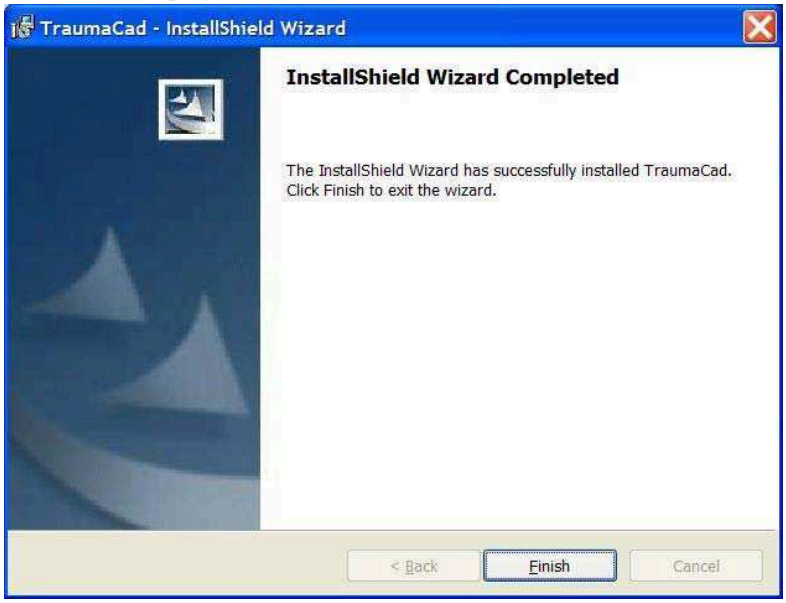
2 Read the License Agreement. If it is acceptable to you, select **I accept the terms of the license agreement** and click **Next** to display the following window:

3 Enter your **User Name** and **Organization**, and then select who you want to be able to access the program. Click **Next** to display the following window:



4 Review the displayed installation settings. If you want to change any of them, click **Back**. If you want to proceed with the installation click **Install**. TraumaCad now starts installing.

5 When the installation is complete the *Installation Wizard Completed* window is displayed.



Click **Finish** to complete the installation process.

Launching TraumaCad

TraumaCad requires an activation key to operate and must be connected to the Web the first time it is launched. A trial activation key is valid for 60 days, after which you can contact your system administrator or Orthocrat sales in order to be sent a permanent one.

► To launch TraumaCad:

1 Double-click the TraumaCad icon that was installed on your desktop:

If this is not the first time that TraumaCad is launched on this computer, the main window is displayed, as shown in the *Quick Tour of the TraumaCad Interface* section on page 16.

If this is the first time that TraumaCad is launched on this computer, the following window is displayed:

2 At this stage, you must enter the activation key provided by Orthocrat in order to launch TraumaCad for the first time. This can be done in any of the following ways:

- Enter the activation key provided on the CD or sent to you in the **Enter Activation Key** field.

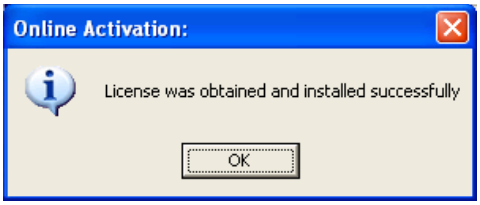
Or

- Click the **Create License Request** button to generate a license request file. Each license request only applies to the computer from which it is generated. Deliver this request file to Orthocrat, for example by email, and a license file will be sent to you. Copy this license file to this computer, and then use the **Install License File** button to activate TraumaCad using this license.

Or

- Click the **Phone Activation** button to display a window showing a key that you should read out to Orthocrat on the phone. Orthocrat will then tell you or send you activation data and a license key that you can enter into the window. Then, click **OK**.

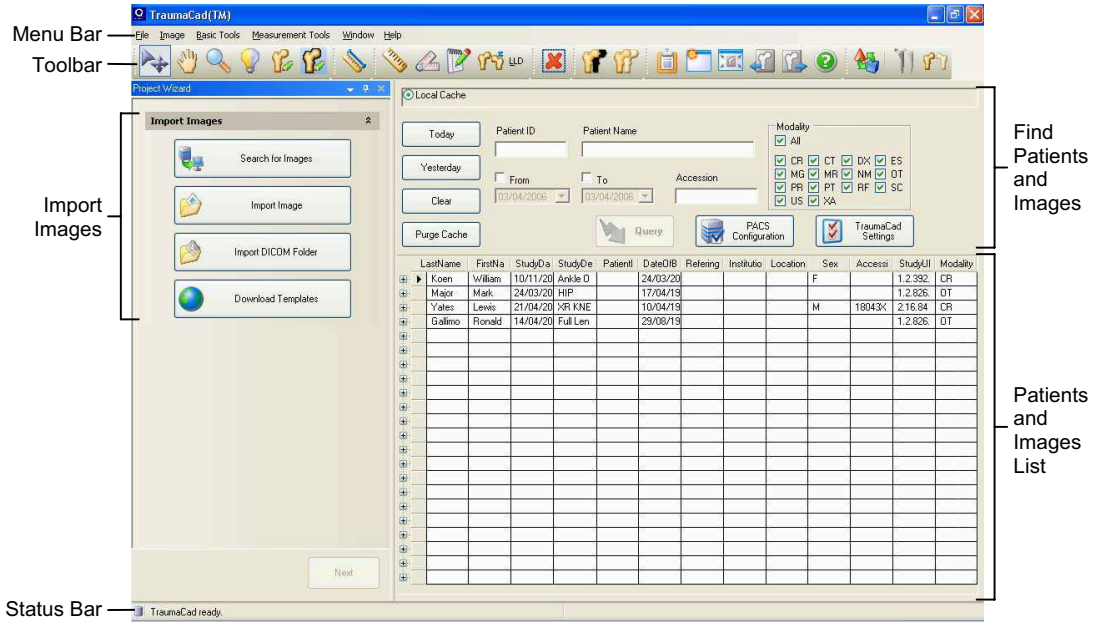
3 Once you enter a valid activation key, the **Online Activation** button becomes active. Enter information about yourself in the displayed window and click **OK** to display the following:



4 Click **OK** to display the main window of the application, as shown on the following page.

Quick Tour of the TraumaCad Interface

This section provides a brief overview of the features of the TraumaCad application, and describes its main window and toolbar. The main window displays a list of patients and their images. It also serves as the main work area in which you can measure anatomy, select an appropriate implant or plan for an operation.



The main window contains the following areas:

- **Menu Bar:** Provides the menu bar options that enable access to various TraumaCad functions.
- **Toolbar:** Provides the tools that enable quick access to TraumaCad's most frequently used functions, as described in the *Toolbar* section on page 17.
- **Import Images:** Provides various options for importing images, as described on page 27, and for downloading implant templates, as described on page 23.

- **Status Bar:** Indicates the status of the application. For example, Querying PACS, Retrieving Images, and so on.
- **Find Patients and Images:** Provides various options for finding the patients and images in the PACS that you would like to study, as described in the *Finding a Patient* and *Selecting the Patient's Images* section starting on page 29.
- **PACS Configuration (Optional):** Enables you to specify the connection properties between TraumaCad and the PACS system, as described in the *Setting the PACS Configuration (Optional)* section on page 22. This option is only relevant for the standalone version of TraumaCad.
- **TraumaCad Settings (Optional):** Enables you to specify various user settings, such as font size color. TraumaCad automatically provides various defaults for these setting and they only need to be modified if you would like to change them according to your preferences. This option is only relevant for the standalone version of TraumaCad.

Toolbar

The following provides a brief description of each of the tools in the TraumaCad toolbar, and when relevant, provides a reference to the section of this guide that provides more information.


Move: Enables you to click on an object in the image and to move this object by dragging the mouse. Click this tool, click on an object that was drawn using TraumaCad on the image, such as an implant, a fragment or textual annotation, hold down the mouse button and then move the mouse to move the object.

 **Pan:** Enables you to move the image itself. Click this tool, click on the image and hold down the mouse button. Then move the mouse to move the image. **You can also use the mouse wheel to pan the image by simply holding the wheel down and then moving the mouse to move the image.**

 **Zoom:** Enables you to zoom in (enlarge) or zoom out (shrink) the image view. Click this tool, click on the image, hold down the mouse button and then drag the mouse up to zoom in or down to zoom out. **You can also use the mouse wheel to zoom by rolling it upwards to zoom in and downwards to zoom out.**

 **Windowing:** Enhances the visible distinction between contrasting tissue regions by manipulating the brightness and contrast. Position the cursor on the image, and click this tool. Left-click on the image and drag the mouse left or right to change the contrast, and up or down to change the brightness.

 **Define Fragments:** Enables you to draw an outline around a fragment to be moved in the image by clicking around its edges, as described in the *Reducing the Bone Fragments* section on page 56.

 **Lasso Fragments:** Enables you to draw an outline around a fragment to be moved in the image by drawing a freehand line around its edges, as described in the *Reducing the Bone Fragments* section on page 56.

 **Calibrate the image:** Enables you to calibrate the selected images, if required, as described in the *Calibrating the Image* section on page 36.

 **Ruler tool:** Enables you to measure a section of the image, as described in the *Ruler Tool* section on page 70.

 **Angle tool:** Enables you to measure an angle, as described in the *Angle Tool* section on page 71.

 **Circle tool:** Enables you to measure the diameter of any round object, as described in the *Circle Tool* section on page 72 and in the *Calibrating the Image* section on page 36.

 **Text Annotation tool:** Opens a window in which you can type in a textual annotation to be shown on the image. When text in added to the image, a line shows the connection between the text and the part of the image to which it applies. You can drag this text away if it is obstructing the view. The line will lengthen and still point to the part of the image to which the text applies.

LLD tool: This tool is used to measure leg length discrepancy, as described on page 73.

 **Delete selected object:** Enables you to delete a selected measurement tool or implant that you have added onto the image using TraumaCad. Click on the object that you wish to delete and then on this tool.

 **Cut Fragment:** Enables you to cut the fragment that you have defined with the **Define Fragment** or **Lasso** tools.

 **Duplicate Fragment:** Once you have cut out a fragment you can duplicate it onto the current image or onto another image. You may decide to duplicate a fragment and then flip it in order to compare a fragment from one limb to another limb. To navigate between images use the **Page Up** or **Page Down** buttons  .

 **Copy to Clipboard:** Enables you to copy the displayed image to the clipboard, including the implants, textual annotations and measurement tools that you added using TraumaCad. From there you can paste it to any other application, such as a presentation.

 **New Case Study:** When you launch TraumaCad, a new case study is opened. Only one case can be open at a time. A case study may have multiple images open, and each may have implants and measurements drawn on it using TraumaCad. Opening a new case study removes all the displayed images from view. Before opening a new case study make sure to generate the required report and/or to commit the image back to the PACS system.

 **Page Up** or **Page Down:** A case study may have multiple images open and each may have implants and measurements drawn on it using TraumaCad. Use these tools to navigate between them.

 **Help:** Displays information about TraumaCad.

 **Transpose:** This tool is used during the Trauma procedure to transpose the orientation of an implant between AP and lateral views.

 **Copy implant:** Duplicates a selected implant.

 **Flip Left-Right:** Flips the selected implant or fragment left or right.

 **Fit to Screen:** Click on this tool to go back to the original image size after zooming in.

Setting the PACS Configuration (Optional)

This optional step only applies to standalone versions of TraumaCad. It enables you to specify the connection properties between TraumaCad and the PACS system. Typically, this only needs to be performed once by a system administrator after the initial installation of TraumaCad. The system administrator should make sure to enter the relevant connection properties in the PACS system so that it recognizes TraumaCad.

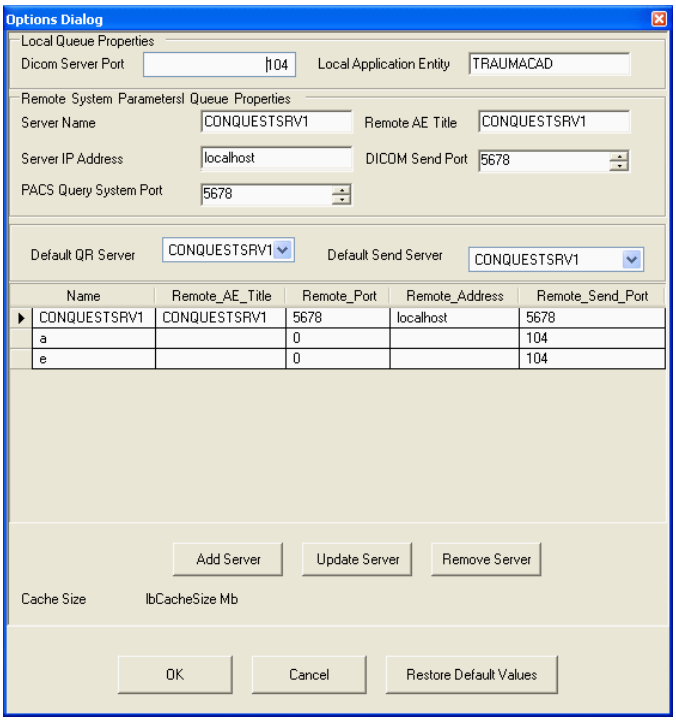
NOTE:

Client/Server versions of TraumaCad can skip this step since it is performed on the server, as described in the *TraumaCad Adminstrator's Guide*.

► To set up the PACS Configuration:

1 Click 

. The *DICOM Properties* window is displayed:



2 Enter the relevant PACS connection information into the appropriate fields. This information should be available to your network administrator.

3 Click **OK** to save and apply these settings.

Downloading Implant Templates

TraumaCad provides a large library of digital templates for a wide variety of orthopedic surgical procedures.

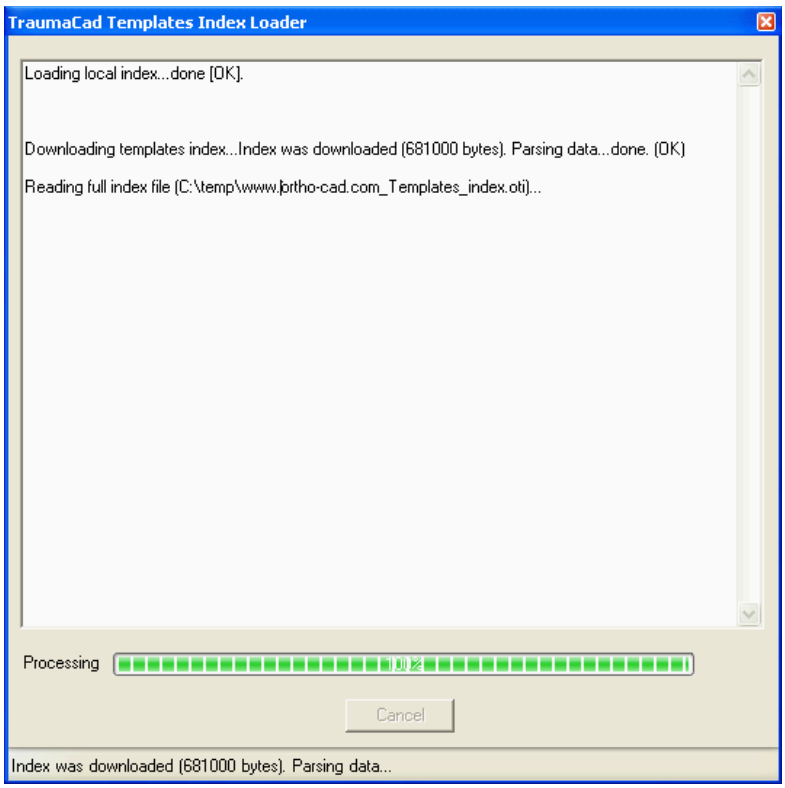
For the server version of TraumaCad, these implant images are automatically imported and updated on your computer from the TraumaCad server.

For the standalone version of TraumaCad, use the 

button in the main window to download templates of implants from Orthocrat's global repository to your computer.

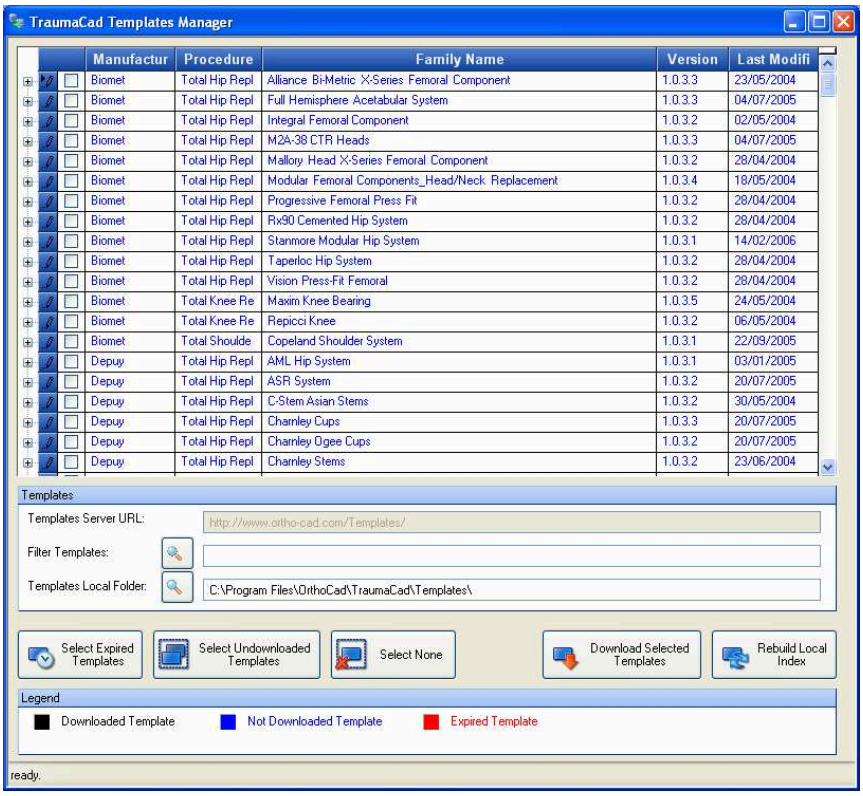
Each implant is provided in a variety of sizes and properties and each such group is called an implant *template*. Several implanting scenarios can be recorded and compared to find the optimal implant procedure. Once an implant is chosen, it can easily be scaled and manipulated.

Before TraumaCad is used for the first time, the implant templates should be imported. This procedure should also be performed from time to time to update the template library.



Templates Manager

After the Templates Downloader is launched, it assesses the locally stored templates and the latest templates on the Orthocrat server.



The window lists the templates stored locally and those on Orthocrat's server. The following describes the legend at the bottom of the Templates Manager window:

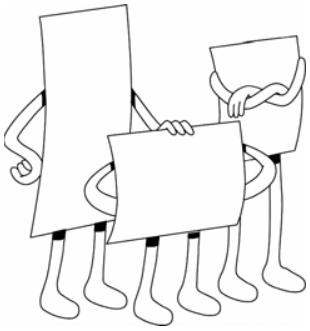
- **Black Downloaded Templates:** Templates which have been stored locally.
- **Blue Not Downloaded Templates:** Templates that are available for downloading from Orthocrat's servers.
- **Red Expired Templates:** Locally stored templates, for which a newer version to be downloaded exists on Orthocrat's servers.

► To download templates to the local client:

1. Select the required templates by clicking the checkbox to the left of the template name.
2. Click **Download Selected Templates** to start downloading the selected templates.
3. (Optional) Search for specific templates (meaning, filter the list of templates) by entering the template name or part of the name in the **Filter Templates** field and clicking the  button to its left.

NOTE:

Rebuild Local index: It may take a long time to rebuild all local indexes. This option should be used rarely and **only** by an administrator, unless templates were downloaded not using TraumaCad or, for example, were copied to the computer from CD.



Chapter 2

Preparing the Image

TraumaCad supports DICOM and enables you to import (and export) any PACS file (X-ray, CT or MR) from a central PACS system, a CD or from a local workstation. JPG, scanner or digital camera images can also be imported, and any image can be captured from the screen and used in TraumaCad. TraumaCad then provides an automatic feature to ensure accurate calibration to bone size.

After an image has been prepared in TraumaCad, you can start the required surgical planning procedure, as described in *Chapter 3, TraumaCad Procedures,* page 45.

Step 1: Displaying the Image

If TraumaCad is integrated into your PACS, then all you need to do to access an image is to display it in the PACS, and then select the TraumaCad option. The option to activate TraumaCad on an image may differ from PACS to PACS. One PACS may activate TraumaCad by pressing a button and another may be by right-clicking on the image and/or selecting a menu option.

The following options are provided for importing images:

- **Loading Images from a PACS,** page 29.
- **Importing Images from a CD,** page 32.
- **Capturing Images from the Screen,** page 33.

Step 2: Specifying Anatomical Orientation

This step must be performed on all the images with which you want to work in TraumaCad, as described on page 34.

Step 3: Calibrating the Image

This step may be performed on images with which you want to work in TraumaCad, as described on page 4.

Loading Images from a PACS

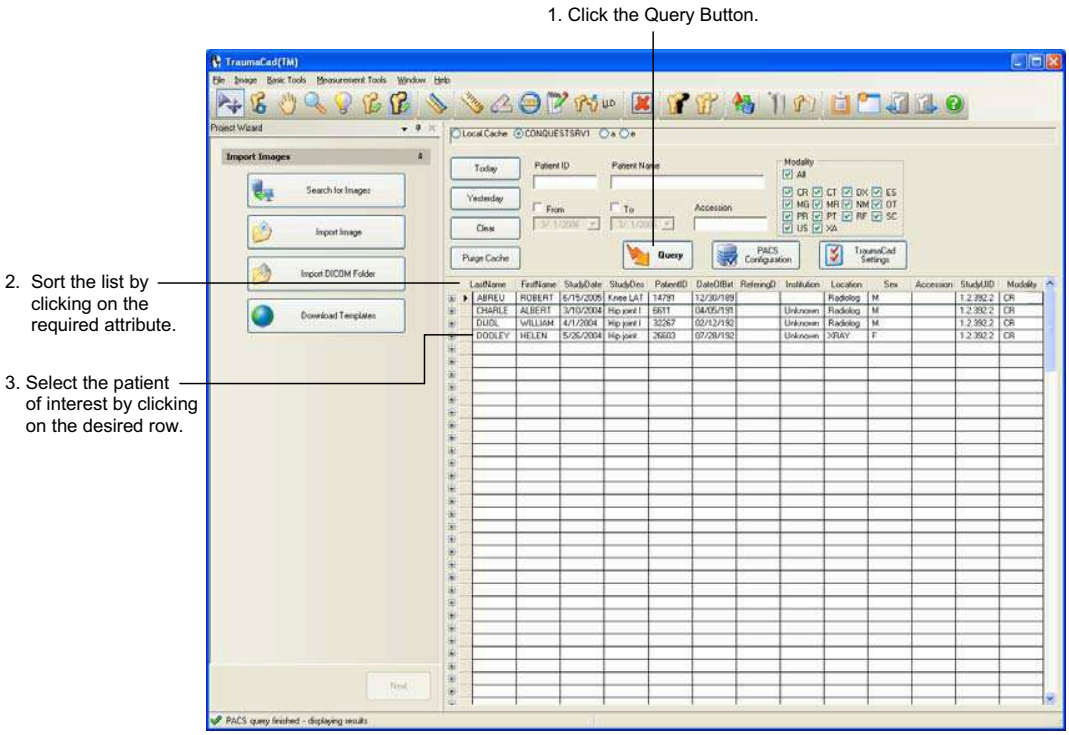
Finding the Patient

TraumaCad is transparently integrated with the PACS system and enables full access to its patient images and information. TraumaCad provides a variety of options for finding a specific patient of interest. After you have found the patient, you can select the images in which you are interested.

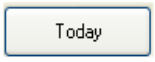
► To find patient, perform any one of the following:

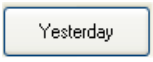
- Click the **Query** 

button to display a list of patients. Typically, this list is sorted by Last Name, then First Name and then Study Date, but this may differ between PACS systems.



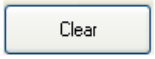
You can scroll down in this list or sort the listed patients by clicking on the name of a column at the top of the list. You can perform any of the following options:

- Click 

or 

to display the patients whose images were scanned today or yesterday accordingly.
- Select the **From** and or **To** check boxes and specify the range of dates of interest. Click 

to see all the images within this date range.
- Enter/select all or some of the patient's information in the Patient ID, Patient Name, Accession and Modality field and click 

. You can also enter part of the Patient's ID or Patient's name.
- Click 

to clear the patient search information that you have entered and the list of patients that is displayed.

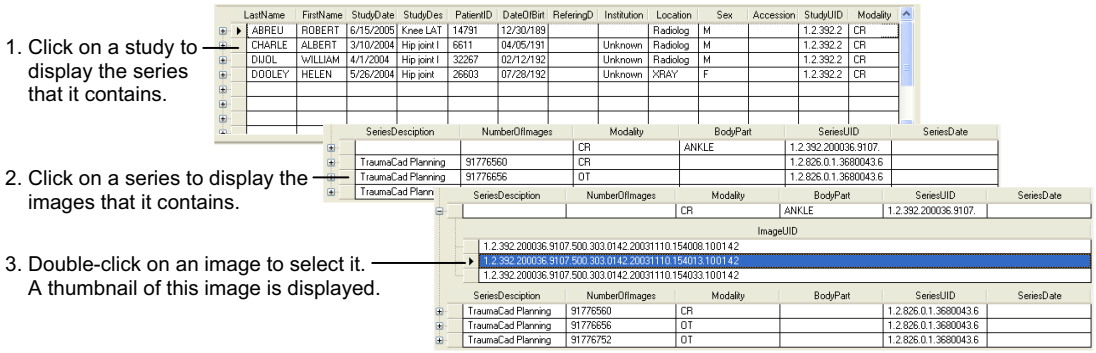
NOTE:

You may click the **Purge Cache** button to clear the cache of images on your local computer.

Selecting the Patient's Images

Once you have found the patient in which you are interested, you can select the relevant images, an entire series or an entire study to be viewed. To select any of these, double-click on the relevant row, or click the plus sign ⊞ to drill down and see the series in a study and then again to see the images in a series. Double-click on an image to retrieve it from PACS and display it in the TraumaCad window.

The following diagram shows how to drill down and select a specific image in a series of a study.



Importing Images from a CD

On the standalone version of TraumaCad, two options are provided for importing images into your local cache on your local computer. You can then commit these to the PACS system if you like. These are:

- 

: Enables you to import a folder of DICOM images to your local cache.
- 

: Enables you to import a single image file that is jpg, DICOM or another file format. A window is displayed in which you can enter the information about this image that will be stored with it.

WARNING!

When importing an image or using an image from the local cache, make sure that you import data from the correct patient, and use the correct image from the correct patient.

NOTE:

You may click the **Purge Cache** button to clear the cache of images on your local computer.

Capturing Images from the Screen

Select the **Screen Capture** option in the *File* menu to capture any image that is displayed on the screen into TraumaCad. The following window is displayed:

Drag the **Finder Tool**  over the image to be captured. It is then added to TraumaCad, and you can later commit it to PACS if you like.

WARNING!

When importing an image or using an image from the local cache, make sure that you import data from the correct patient, and use the correct image from the particular patient.

Specifying Anatomical Orientation

After the images in which you are interested have been loaded from the PACS or imported from a CD or your local computer, as described in the previous sections, each of these images are displayed in the sidebar on the left of the window. An example is shown below:

You can scroll up and down among the images that you have selected, if you have selected more than two, and you can minimize the images of a specific series, by clicking  .

You can also scroll among the large images shown in the center right of the window using the  **Page Up** or **Page Down** buttons in the tool bar.

You should now indicate the anatomical orientation of each image, as described below.

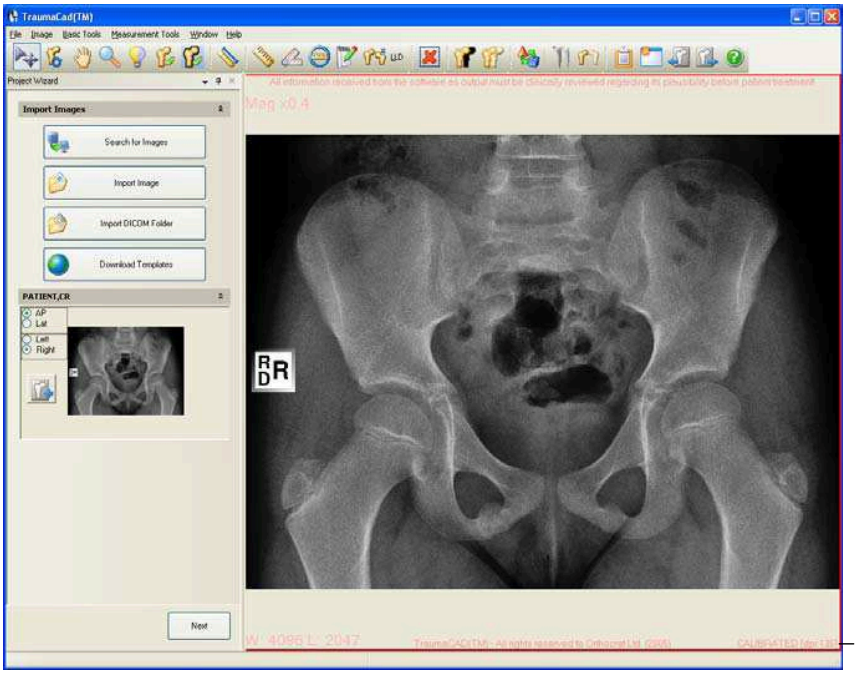
► To indicate the anatomical orientation of each image:

1. Select whether the displayed image is **AP** or **Lat** by clicking on the appropriate radio button. This step is mandatory.
2. Specify the side of the body shown in the image as **Left** or **Right**, by clicking on the appropriate radio button. This option is not mandatory.
3. You can display the image in the main work area by double-clicking on its thumbnail image or by clicking  , as shown below:

As shown above and as described in the section that follows, the *Calibration* window is then automatically displayed.

Calibrating the Image

To use an image for quantitative measurements, the image must be calibrated to the actual bone size. The calibration status of the image appears in the lower right corner of the image, as shown below.



Most images imported from PACS are already calibrated according to the cassette. One of the most beneficial features of TraumaCad is its ability to automatically calibrate an image to the actual bone size by calibrating the image to a marker that is imaged with the patient.

For this purpose Orthocrat provides a spherical metal X-ray marker with a diameter of 1 inch. The metal ball should be placed on the same plane (meaning the same height or level) as the bone while performing the x-ray. TraumaCad can then automatically detect this marker in an image and calibrate the image to the actual bone size according to it.

X-ray Scaling

Direct linear measurements cannot be taken from plain x-rays because of the unknown magnification factor inherent in the x-ray taking process.

X-rays are generated at a source point and radiate out from that point in a divergent beam. The beam is directed through the person or object to be imaged and then the shadow is recorded on the x-ray sensitive plate some distance behind the object.

There are two ways of determining the magnification factor, as follows:

- To know the distance from the source of the x-rays to the object and the distance from the source to the x-ray plate.
- To include an object of known size or a radio opaque ruler in the plane of interest.

Calibration Sphere

Orthocrat's spherical metal X-ray marker scaling device is, of course, of the second type mentioned above. This device is intended to be used to provide a scale for plain x-rays, CR and DR (such as those commonly used in orthopedics). The scaling sphere should be placed in the same plane as the bone. The bone and sphere should therefore be the same distance from the x-ray plate and the x-ray source.

When an x-ray image is scaled using a ruler or simple object, it is impossible to verify whether the scale was placed in the correct plane at the time of acquisition. The advantage of the sphere is that it is three-dimensional and its diameter is constant from any angle that the x-ray is taken.

NOTE:

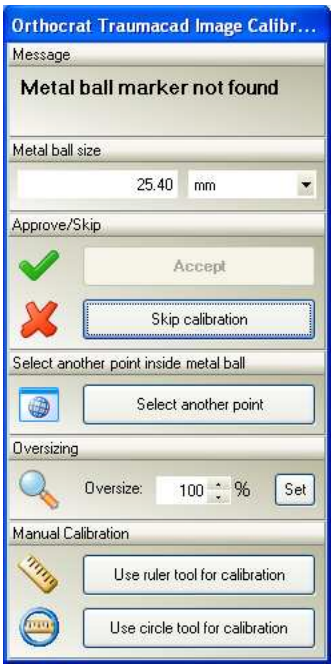
Measurements performed on uncalibrated images are in pixel units, while in calibrated images they are in millimeters.

Calibration Window

As shown previously, the selected image is displayed with a *Calibration* window, which provides various options for calibrating the image. After calibration is completed, as described in this section, click **Accept** or **Skip Calibration** and proceed to *Chapter 3, TraumaCad Procedures* On page 45.

The *Calibration* window appears as follows depending on whether Orthocrat's spherical metal x-ray marker is found or not.

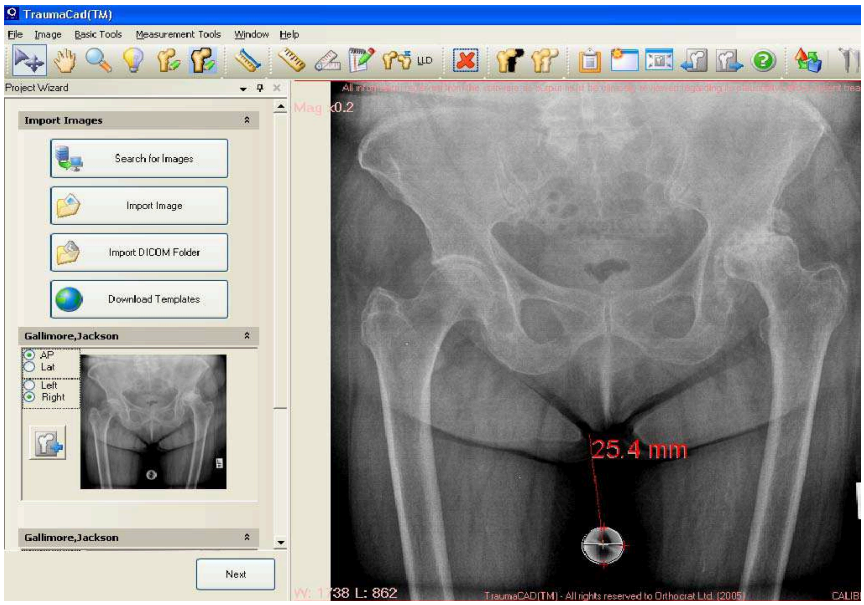
Found

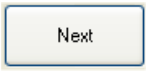


Not Found

If the marker is found, the message **Metal Ball found where shown** is displayed in the window shown above. In this case you can click the **Accept** button.

The selected image is then displayed in the work area, as shown below:



You can now click 

and proceed to *Chapter 3, TraumaCad Procedures* on page 45.

Even if the metal ball is found, you may decide to manually or semi-automatically calibrate the image, as described in the *Calibrating the Image* section below.

If you decide not to calibrate the image, then click **Skip Calibration**  and proceed to *Chapter 3, TraumaCad Procedures* on page 45.

The following describes the various options for calibrating an image.

Calibrating an Image

If no marker is detected, you have three options, as follows:

- to **Skip Calibration** by clicking  .
- to manually indicate the position of the marker to which to calibrate, as described below.
- to manually resize the image by entering a percentage in the **Oversizing** field (for example 15%) and clicking 

.

Manually Indicating the Marker in the Image

To manually indicate the position of the marker you have three options:

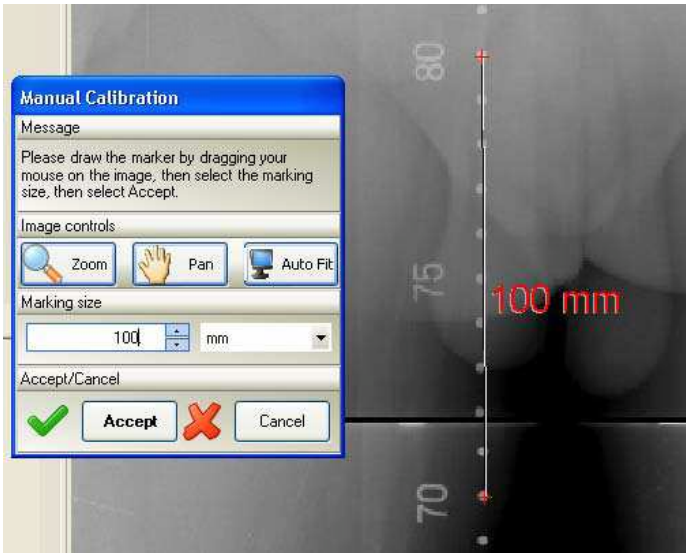
 To click on the spherical metal x-ray marker

This is a semi-automatic option which detects the entire spherical marker once you click anywhere inside it in the image. To do so, click **Select another point**  and then click inside the marker on the image.

To use the Ruler tool

Use the **Ruler** tool to measure a section of the image whose size is known to you. Click **Use Ruler tool for calibration** to display the following window:

Draw a line to indicate the size of the marker in the image the size of the line is displayed on the image and changes as you draw and resize the line, as shown below:



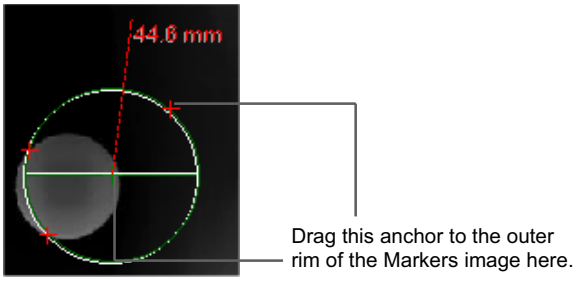
The size of the line is also shown in the **Marking size** field. If you know that the marker's actual size is one inch, then make sure that the **Marking size** field shows that value. You can manually change it to adjust the size of the line in the image.

When the line exactly covers the extent of the marker in the image, click **Accept** .

To use the Circle tool

Click **Use Circle tool for calibration** to display the following window:

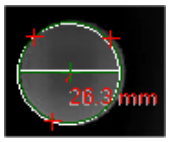
Click on the marker in the image. A circle marker is automatically drawn, as shown below:



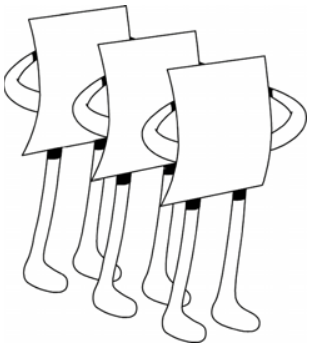
Drag this circle to exactly cover the marker.

You can resize the circle, by manually changing the value in the **Marking size** field. If you know that the marker's actual size is one inch, then make sure that the **Marking size** field shows that value.

You can also easily set the size of the circle to exactly cover the marker's image, by manually positioning (dragging) each of the three anchors (red plus signs) of the circle onto the outer rim of the marker's image.



The diameter of the circle is displayed on the image and changes as you draw and resize the circle. When the circle exactly covers the extent of the marker in the image, click **Accept** .



Chapter 3

TraumaCad Procedures

After you perform the three steps described on the first page of *Chapter 2, Preparing the Image* on page 27, you have clicked **Accept** to accept the image's calibration or **Skip Calibration** to skip it and have then clicked Next. A list of procedures is then displayed for your selection, as shown below:

Select the surgical or analysis procedure to be performed on the patient. A simple wizard will then lead you through the process of performing each procedure, such as selecting and positioning an implant, if required.

The following describes each of these procedures and refers you to the section of this chapter that contains detailed instructions.

- **Joint Replacement Procedures**, page 46.
- **Trauma,** page 53.
- **Pediatric Pelvis Tool,** page 60.
- Once you have completed each procedure you should generate a report including textural information and transfer it to the OR, as described in the *Generate Reports* section on page 65, and then commit the image back to the PACS system, if required for future reference.

Joint Replacement Procedures

TraumaCad optimizes joint replacement procedures and is ideal for complex reconstructions and osteotomies, as well as for standard primary replacements. Surgeons can evaluate the post-operative anatomical alignment of various surgical scenarios (cutting, displacing, implanting) to create an optimal surgical plan. Incorporated into the patient file, this plan helps ensure the success of the procedure, while reducing operating time. TraumaCad offers a large and easily accessible template library for joint replacement. This library is constantly updated automatically through the server or manually in the standalone version.

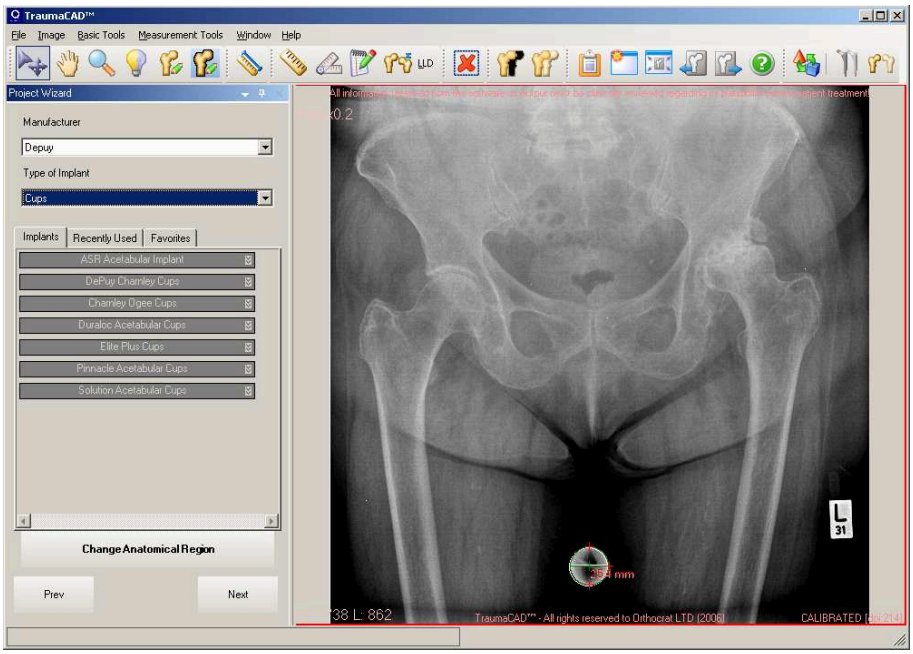
Joint replacement procedures are similar for hip, knee, ankle, shoulder and elbow. Refer to the following sections for a description of the main steps of these procedures:

- **Selecting an Implant,** page 47.
- **Specifying Implant Properties,** page 50.
- **Positioning an Implant**, page 52.

Selecting an Implant

Read this section if you selected one of the replacement surgical procedures or if you are placing an implant in one of the other procedures, such as Trauma. The process of using TraumaCad for each of the replacement procedures (hip, knee, ankle, shoulder and elbow) is similar.

Of course, the implant library differs for different anatomical regions, such as a hip or a knee. The following window is shown when you select one of the joint replacement procedures:

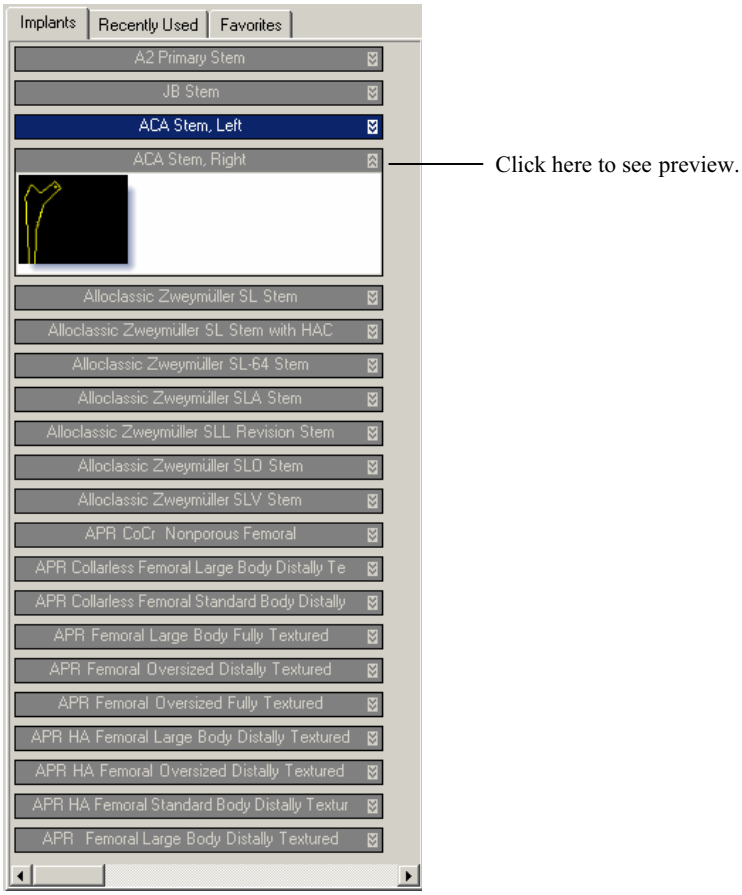


At this point you may want to use any of the variety of measurement tools provided by TraumaCad to measure the anatomical region of the patient, as described in *Chapter 4, Measuring*.

The process of identifying the required implant is also referred to as *Templating*. During this process you will first select the appropriate implant according to the available inventory, size and a variety of other properties. You will then position it on the image on the appropriate anatomy.

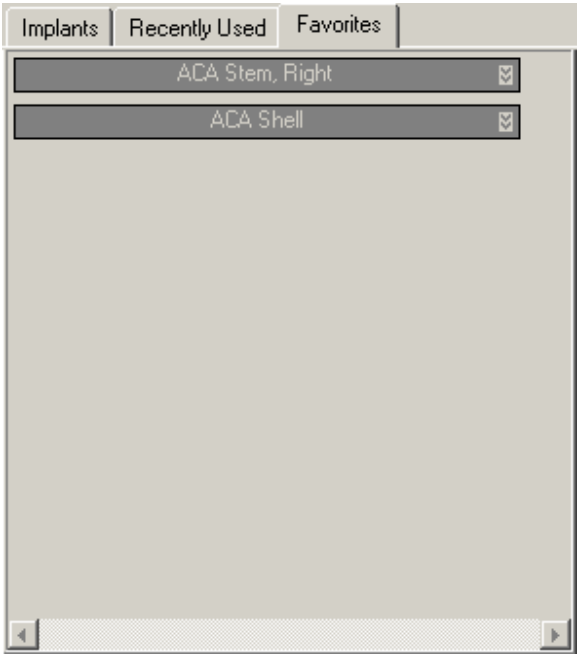
► To select the appropriate implant(s):

1. Select the manufacturer of the implant from the **Manufacturer** field. Selecting a manufacturer determines the types of implants that are available for selection in the **Types of Implant** field.
2. Select the type of the implant from the **Types of Implant** field, such as stems.
3. Select the implant product family from the **Implants** field. Many implant products may be available for selection and you can scroll right or left using the scroll bar under this list to see them all.
4. Click on the arrow  next to the implant product to see a preview image of the implant, as shown below:



► To save an implant in the Favorites tab:

1 Select the implant product family from the Implants field. Many implant products may be available for selection and you can scroll right or left using the scroll bar under this list to see them all.



Specifying Implant Properties

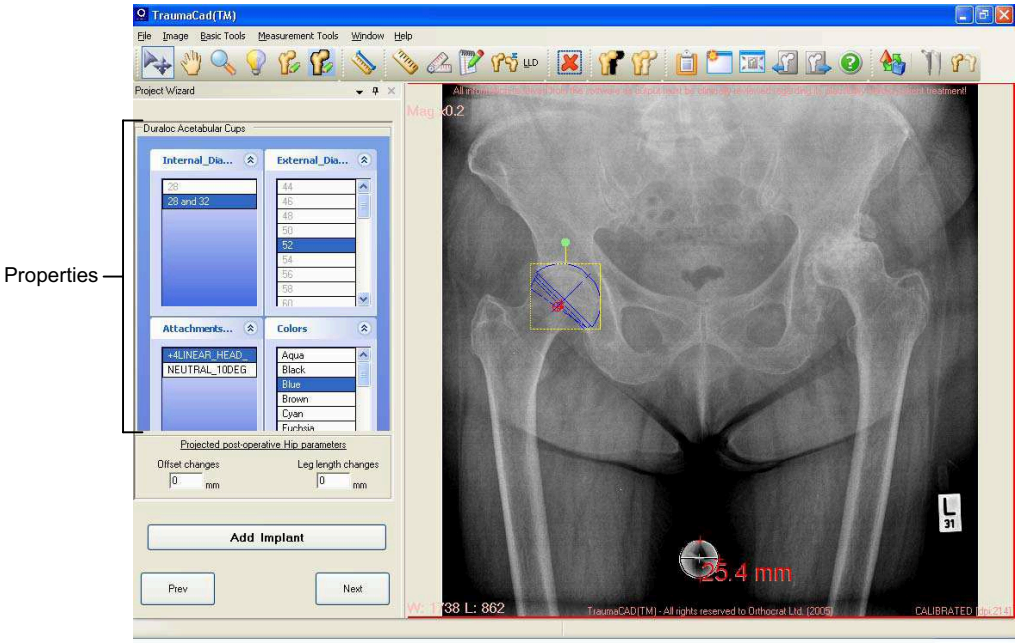
Once you have selected the required implant you can position it on the image and specify more properties of the implant to suit the surgical procedure, such as its size, offset and number of attachments. You require more than a single implant for a specific surgical procedure, such as a stem and a cap.

► To specify implant properties:

1 Double-click on the implants name in the implants list on the left. This will place the implant in the center of the image.

or

Drag the implant from the list on the left onto the image.



A selection of properties appears on the left, as shown above.

2 Specify the properties of the implant to suit the surgical procedure, such as:

- the size of the implant in the **Size** field.
- the length of the implant in the **Length** field.
- the angle between the pieces of the implant in the **Offset** field.
- the color of the implant shown in the image in the **Color** field.
- the neck length of the implant attachments in the **Attachment** field.

These properties differ according to the implant that is selected.

3 While selecting the appropriate implant for total hip replacement, take note of the projected post-operative parameters: **Offset** and **LLD** changes area on the bottom left of the window. These will indicate the anatomical changes that will occur as a result of the procedure.

4 If at any point you want to place another implant on the image, simply click the 

or the 

button.

5 If at any point you want to delete the selected implant from the image, simply select it and press the **Delete** key or the **Delete Selected Object**  tool.

Positioning an Implant

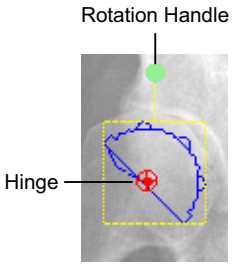
You should position the implant on the image according to surgical considerations. A number of options are provided to enable you to position an implant on the image.

► To move an implant:

Make sure that the **Move**  tool is selected, click on the implant and drag it to the required position.

► To rotate an implant:

The selected implant is indicated by its light (highlighted color) and a rotation handle, as shown below:



Drag the rotation handle to the left, right, up or down to pivot the implant around its hinge.

You can also flip an implant using the  **Flip Left-Right** tool, and change it from AP to LAT and vice versa by using the  **Transpose** tool.

After selecting and positioning of the implant you can continue to the second x-ray of the patient by clicking **Next/Previous**  . The selected implant automatically appears in the new orientation. You should position it on the image.

Trauma

TraumaCad is designed to meet the needs of the trauma environment. TraumaCad enables you to define fracture fragments, move, rotate and copy fragments on the image and between images to reconstruct on the healthy side and accurately restore the anatomy on multiview images prior to templating.

If you selected the **Trauma** surgical procedure, the steps for handling a patient are identical to a replacement procedure except for the following two steps:

- **Specifying the Anatomical Region,** page 54.
- **Defining and Reducing the Bone Fragments,** page 56. You may try different options for reducing the fragments and then select the optimal one.

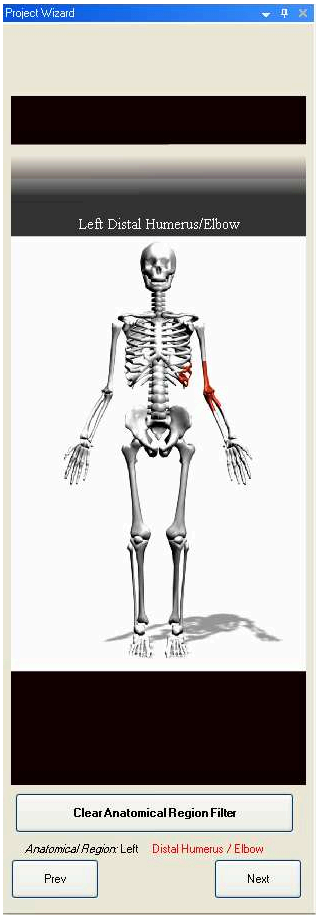
Specifying the Anatomical Region

After you select Next, the following window is displayed:

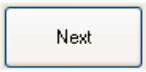
► To specifying an anatomical region of the body:

1 Move the mouse over each relevant area of the body on the skeletal image on the left. As you do so, it is highlighted in red.

2 Click on the relevant part of the body, to display the following:



Reducing the Bone Fragments

Click 

to display the list of implants used in the image if there are any, as shown below:

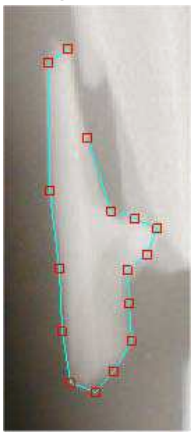
Two tools are provided to define the bone fragments in the image:

Define Fragments  and **Lasso**  , as described below:

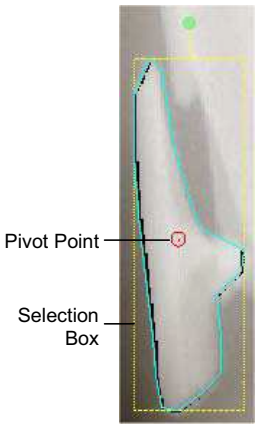
Defining Fragments

► To define fragments:

1 Select the **Define Fragments**  tool and make a series of clicks along the outline of the fragment to be moved.



2 Close the outline drawing of the fragment by double-clicking. You now have a closed shape that you can drag to a new position, as shown below:



You can now reposition or adjust the selection of the fragment as required using any of the following options:

- You can press the **Esc** key to delete the selected outline.
- You can reshape the fragment outline by dragging any of the red points on the outline.
- The dot in the center of the fragment that you have traced is the pivot point. If you drag the handle, the fragment will rotate around it. You can also drag this pivot point to a new position and then rotate the fragment by dragging its handle.
- You can flip this fragment using the  **Flip** tool.
- You can duplicate this fragment, copy it to another image and delete it, using the  **Duplicate Fragment,**  **Copy to Clipboard** and the  **Delete Selected Object** tools.

Lasso Fragments

Lassoing fragments means to simply draw a line around the area of the image that contains the fragments to be moved.

► To lasso fragments:

1 Select the  **Lasso** tool.

2 Click and hold down the left mouse button and drag the mouse around the area to be moved. A line will be drawn as you move the mouse, as shown below:

3 After the fracture is reduced, you can add implants for fixation. For details on how to perform this procedure, refer to the sections listed below:

- **Selecting an Implant,** page 47
- **Specifying Implant Properties,** page 50
- **Positioning an Implant,** page 52

Pediatric Pelvis Tool

TraumaCad enables orthopedic surgeons to take anatomical measurements, compare them to normative standards and to simulate corrective procedures. Easy-to-use wizards help surgeons produce a wide range of anatomical measurements. Each measurement is automatically compared to the normal parameters published in the literature, providing instant evaluations of patient anatomy. Measurements and evaluations integrate into patient files for an easy transition to digital radiology.

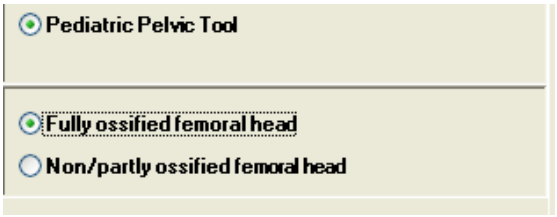
The steps for using TraumaCad for pediatric analysis are as follows:

1. Select **Pediatric Pelvis Tool.**
2. Use the easy to follow wizard to mark anatomical points on the image for pediatric analysis, as described in the *Marking Anatomical Points for the Pediatric Pelvis Tool* section on page 61.
3. You have the option to use TraumaCad's comprehensive growth calculator tool, as described in the *Growth Calculator* section on page 83.
4. Generate a report including textural information and transfer it to the OR, as described in the *Generate Reports* section on page 65.
5. Commit the image back to the PACS system, if required for future reference.

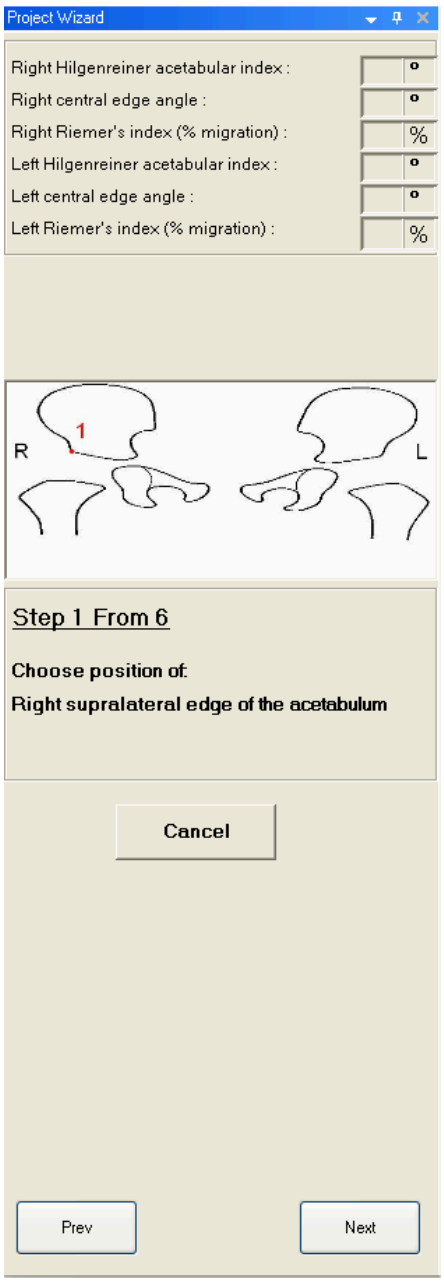
Marking Anatomical Points for the Pediatric Pelvis Tool

If you selected the **Pediatric Pelvis Tool** surgical procedure, the following window is displayed:

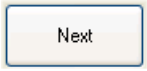
Specify whether the Fermal head is fully, partially or non-ossified by selecting the appropriate radio button on the left



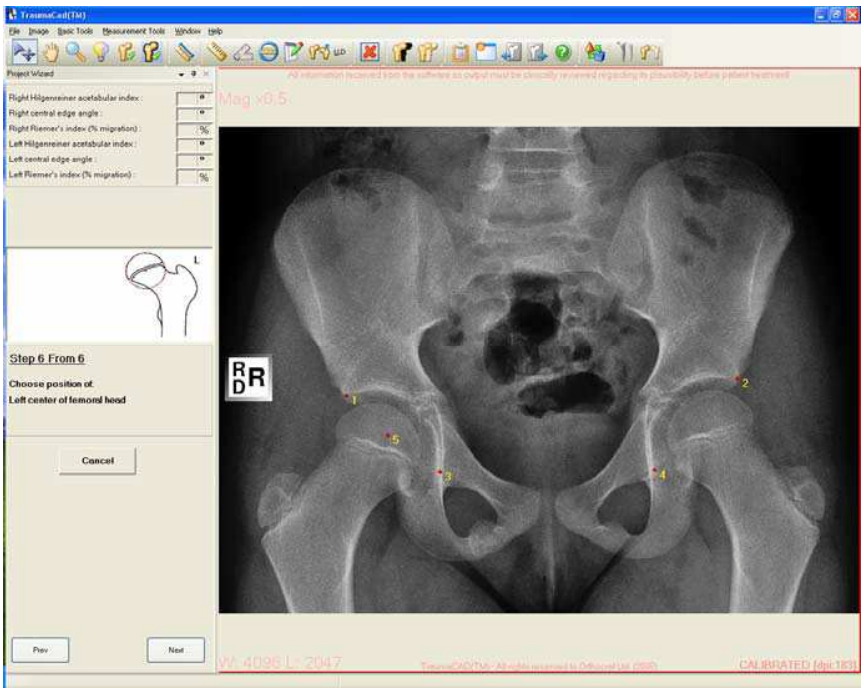
Then, click  to display the following:



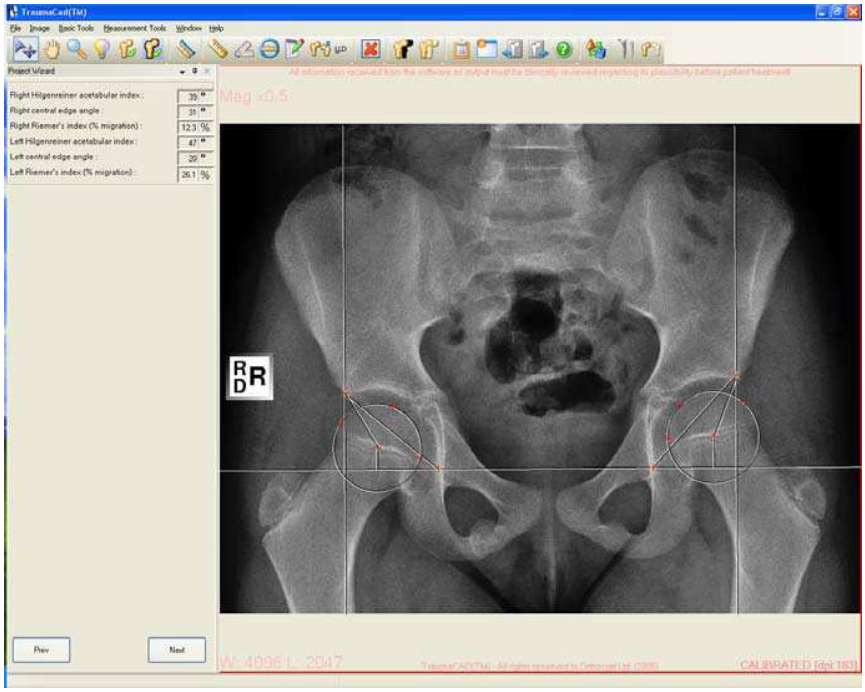
A wizard is displayed on the left which guides you through the process of identifying anatomical markers by clicking on them in the image.

Following the displayed instructions and click 

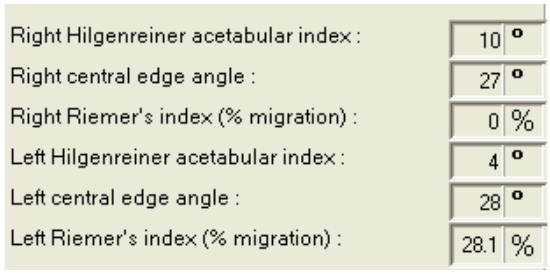
each time after you perform them. The following shows an example of the image after the fifth point has been marked:



Once you mark the sixth point according to the instructions provided in the sixth step of the wizard, the following is shown:



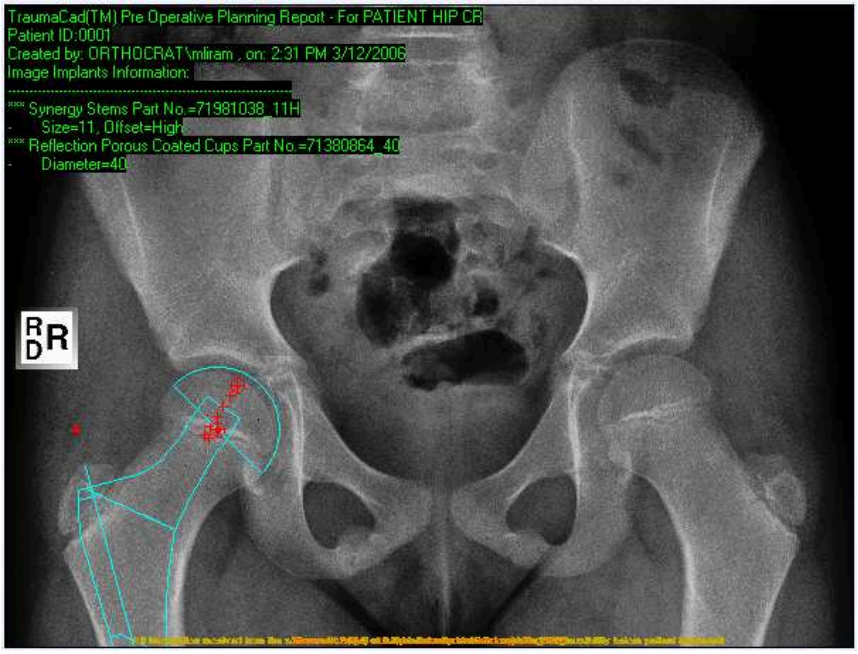
The Anatomical measurements are shown in the top left corner of the window.



Generating Reports

A report consists of textual information describing the patient, the measurements, the surgical procedure to be performed and/or the implant to be used and any text that the surgeon chooses to add.

The image appears with a textual overlay, measurement tools and the implants, as shown below, and can be committed back to the PACS for future reference.



WARNING!

The material generated by the program is two dimensional. Before performing a procedure confirm that the actual bone matches the image produced by the software.

An example of an HTML textural report is shown below. It can be saved locally or printed for future reference.

TraumaCad™
Pre Operative Planning Report
3/12/2006 2:31:50 PM

Referring Physician:
Created By: ORTHOCRAT\mliram
Patient Details
ID: 0001
Name: PATIENT HIP CR
Date of Birth: 5/3/1996 12:00:00 AM
Sex: F

Operation Details
Procedure planned: ***
Procedure side: Right

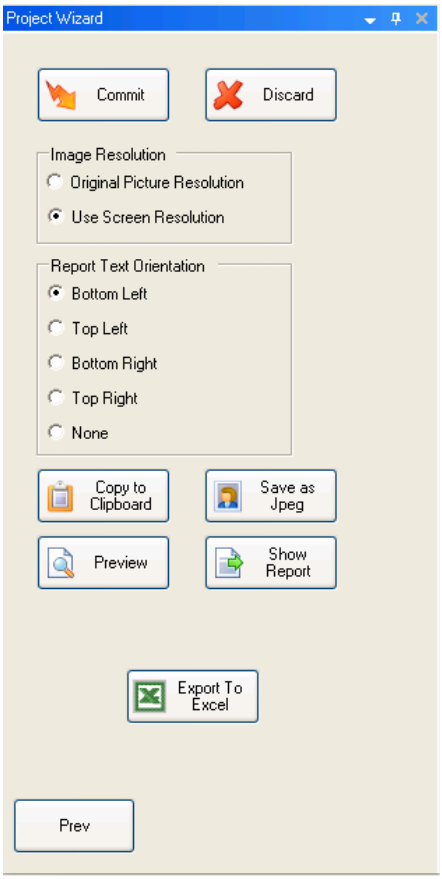
Planning Results
X-Ray: HIP PELVIS
Templating view: AP
Templating side: Right
X-Ray Image size: width = 1960 pixels height = 1488 pixels

==========

Image Implants Information
Implant title Reflection Porous Coated Cups * 1
Part N° 71380864_40
Diameter 40
Implant title Synergy Stems * 1
Part N° 71981038_11H
Offset High
Size 11

► To generate a report:

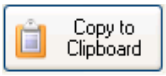
After you have specified an implant's properties and positioned it as required, click Next, as described in the *Specifying Implant Properties* section on page 50. The following is then displayed:

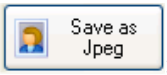


The following options are provided:

- To select the image's resolution and position of the text on the image.
- To select the positioning of the text on the report.

- To click the 

button in order to store this image in the PACS system along with all the TraumaCad additions for future reference.
- 

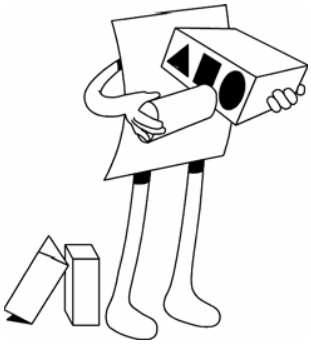
: To copy the image to the clipboard from which you can paste it into any application.
- 

: To save the image locally as a JPEG file for any purpose.
- 

: To display an HTML textual report. Please save this report or print it before opening anther case study.
- 

: To preview the image to be stored.
- 

: To export the measurements to an excel sheet. This option is especially suited for research since each measurement is added as a row in the excel sheet file that you specify. This enables you to perform numerous measurements, even on different images, and to store them in the same excel sheet, each measurement as a row.



Chapter 4

Measuring the Anatomy

After you have calibrated the image you may want to measure the actual anatomy in the image using a variety of tools provided by TraumaCad.

All of TraumaCad's measurement tools can be accessed from the *Measurement Tools* menu. The most frequently used tools can also be accessed from the toolbar and by right-clicking on the image. These are described below. The other tools can be used digitally in the same manner that they are used for physical measurements.

NOTE:

To obtain quantitative measurements the image must first be calibrated, as described in the *Calibrating the Image* section on page 36.

This chapter also describes the Growth Calculator on page 83 which predicts the growth of a particular anatomy in pediatric orthopedics.

Ruler Tool

The **Ruler** tool enables you to measure selected portions of an image either in pixels (for uncalibrated images) or millimeters (for calibrated images).

► To use the Ruler Tool:

1. After loading an image, either click the **Ruler** tool or select the *Measurement Tools* menu ➔ **Basic Measurements** ➔ and the **Ruler Tool** or right-click on the image and select **Rule Tool**.

2. Left-click and hold the left mouse button on the image where you want to start measuring.
3. Drag the mouse without releasing the left mouse button until the end of the section to be measured.
4. Release the mouse. The measurement appears in pixels or millimeters above the measurement bar as shown above.

Angle Tool

The **Angle** tool enables you to measure the angle between two areas.

► To use the Angle Tool:

1. Click  or select the *Measurement Tools* menu ➔ **Basic Measurements** ➔ and the **Angle Tool** or right-click on the image and select **Angle Tool**.

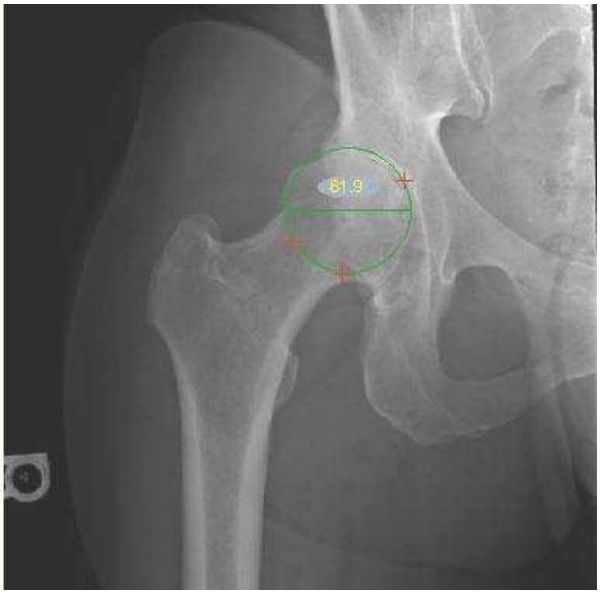
2. Left-click and hold the left mouse button on the image where you want to start measuring.
3. Drag the mouse without releasing the left mouse button until you reach the end of the section to be measured.
4. Release the mouse button. The measurement will appear in degrees next to the angle as shown above.

Circle Tool

Use the **Circle** tool to measure the diameter of round objects.

► To use the Circle Tool:

1. Click  or select the *Measurement Tools* menu ➔ **Basic Measurements** ➔ and the **Circle Tool** or right-click on the image and select **Circle Tool**.
2. Left-click on the image in the work area. The **Circle** tool appears.
3. Left-click and hold the mouse button inside the circle and drag it to the desired position, as shown below.
4. Click and drag on each of the three crosses in turn to adjust the size of the circle.
5. The diameter measurement (in millimeters if calibrated) appears in the upper half of the circle



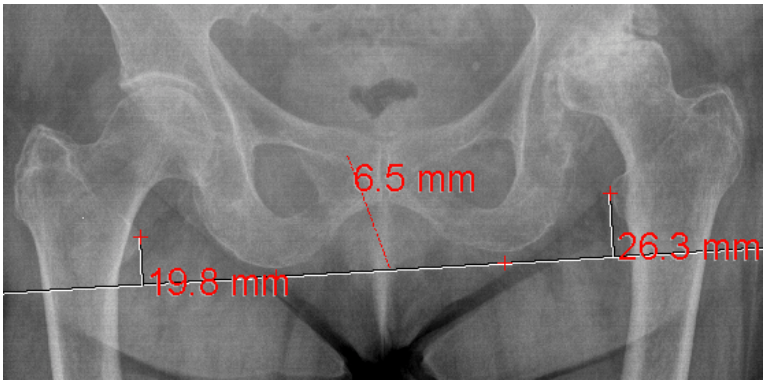
Leg Length Discrepancy Tool

The **LLD** tool enables you to measure leg length discrepancy.

► To use the LLD Tool:

1. Click  or select the *Measurement Tools* menu ➔ **Basic Measurements** ➔ and the **LLD** Tool or right-click on the image and select **Pelvic Tool**.
2. Left-click on the image in the work area. The Pelvis Tool appears.
3. Using the red markers adjust the tool to reference points in order to measure the leg length discrepancy, meaning the ischial tuberosity and the center of the lesser trochanter, as shown in the image.

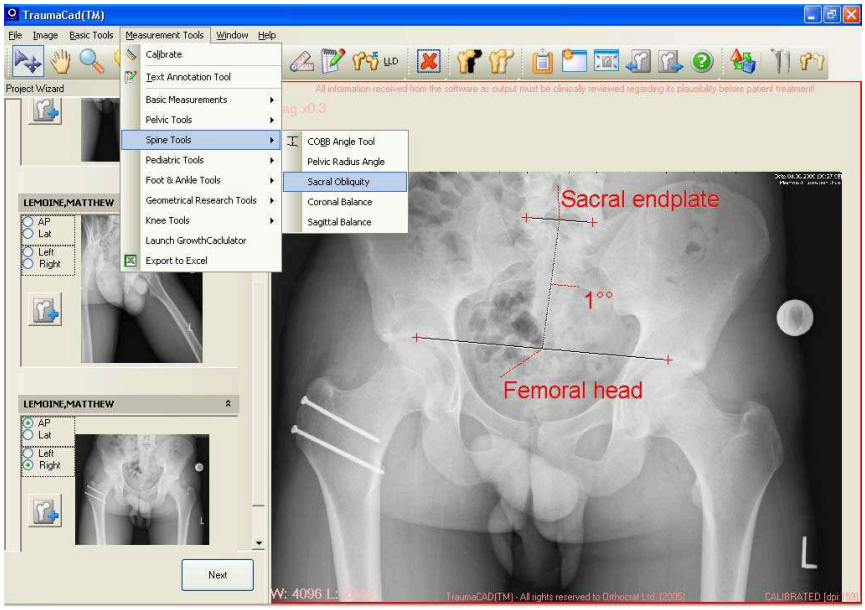
   The number above the horizontal line indicates the discrepancy between the right and left side in the distance between the two points. If there is no discrepancy the number 0 will appear.



Spine Tools

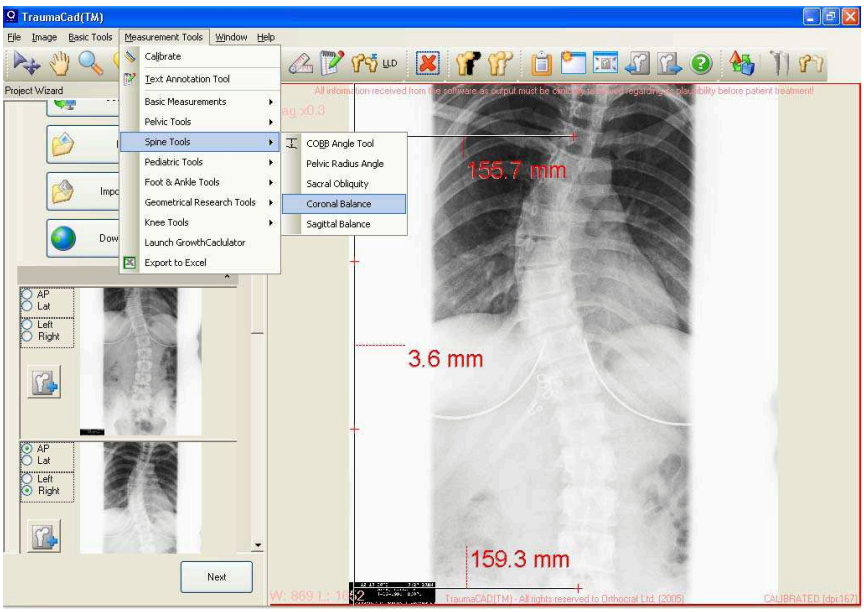
Sacral Obliquity

This tool measures the angular deviation of the sacrum from the line drawn parallel to a line across the femoral heads on a supine AP view of the sacrum, as shown below:



Coronal Balance

This tool measures the difference in millimeters between two lines that are drawn perpendicular to the film edge at an AP view: the first to the center of S1 vertebra and the second to the center of C7 vertebra.

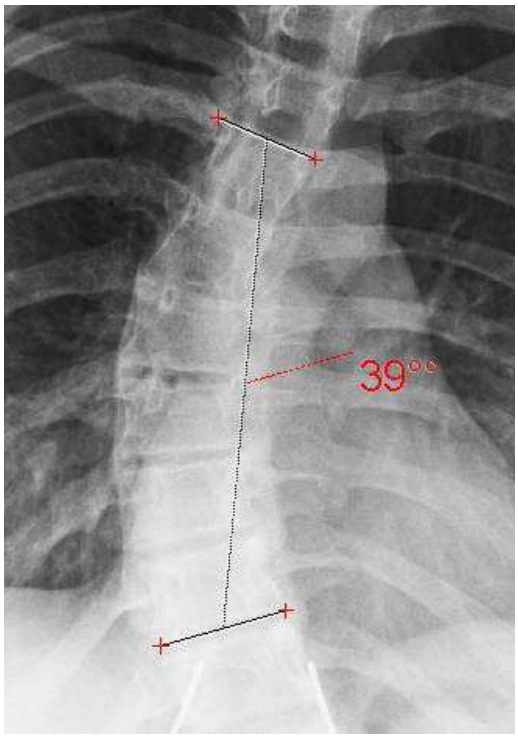


Sagittal Balance

This tool measures in a similar manner to the Coronal Balance, described above, but for the LAT view.

Cobb Angle

This tool measures the coronal and Sagittal spinal deformity as shown below:

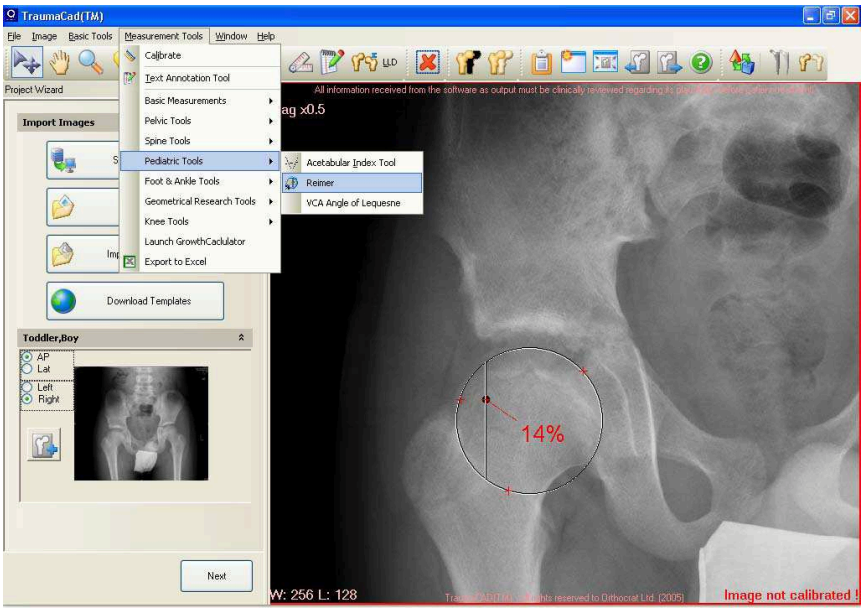


Pediatric Tools

Reimer Index

The Reimer Index tool (the hip migration percentage) first measures, in the horizontal plane, the part of the femoral head extending lateral to a vertical line drawn from the lateral edge of the roof of the acetabulum (the Perkins line). The migration percentage is then calculated by dividing this value by the entire width of the visible part of the femoral head.

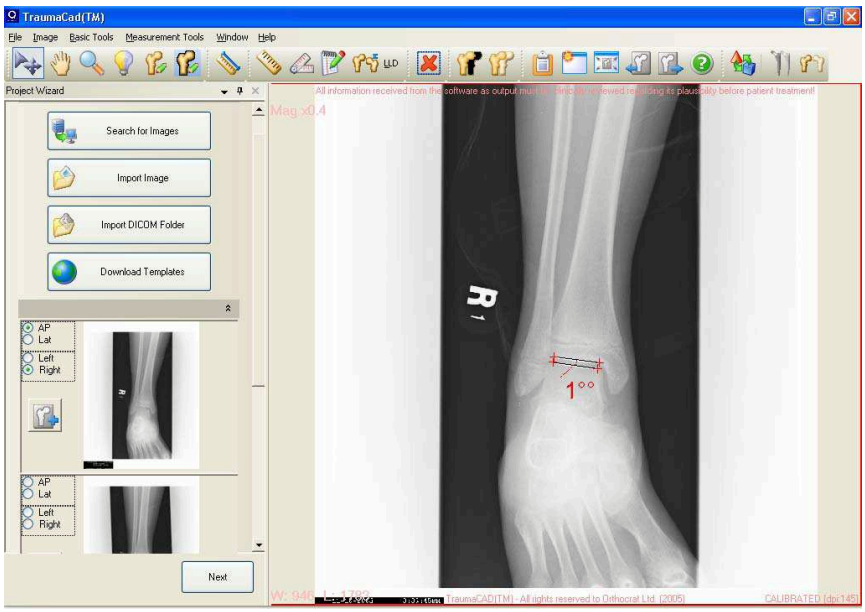
We recommend on using the Pediatric Pelvis Tool, as described on page 60, in which Reimer Index calculation is guided.



Foot and Ankle Tools

Talar Tilt Tool

This tool measures the angle between a line drawn parallel to articular surface of distal tibial to a line drawn parallel to talar surface.

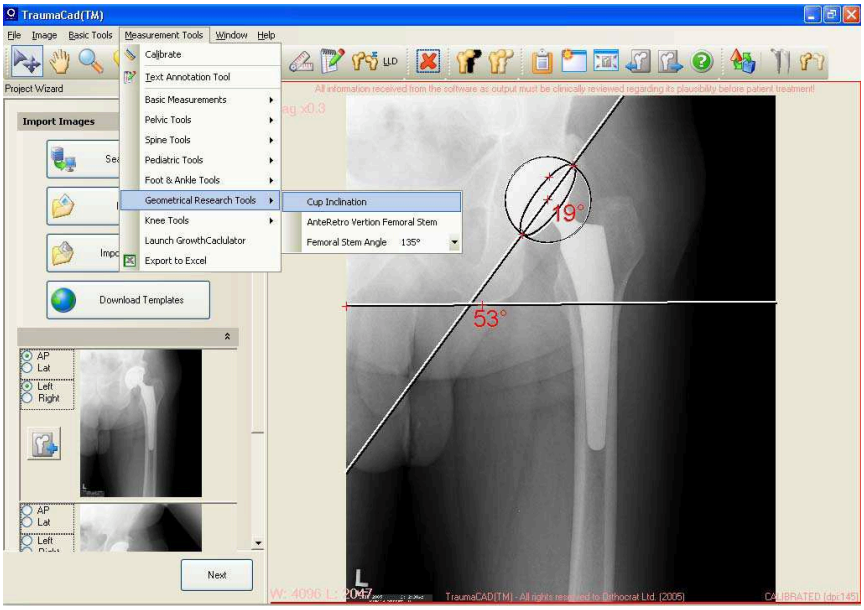


Geometrical Research Tools

These tools are made to evaluate the positioning of the hip implants postoperatively, they are important for research and quality control.

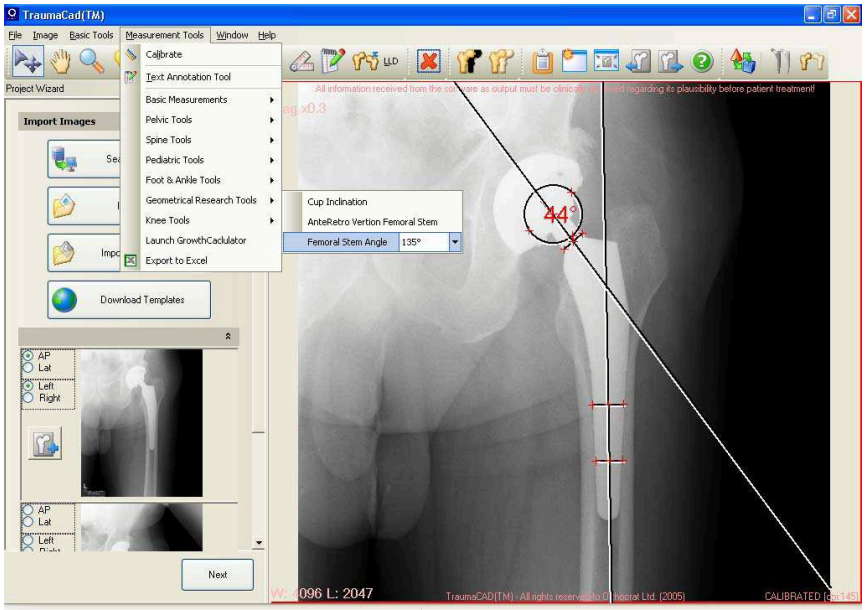
Cup Inclination

- The horizontal line should be adjusted to the ischial tuberosity.
- The oblique line (and with it the outer circle) should be adjusted to distalomedial and proximolateral ends of the implanted cup.
- The inner circle should be adjusted to the opening of the implanted cup.
- The cup abduction and ante-retroversion are displayed.



AnteRetro version of the Femoral Stem

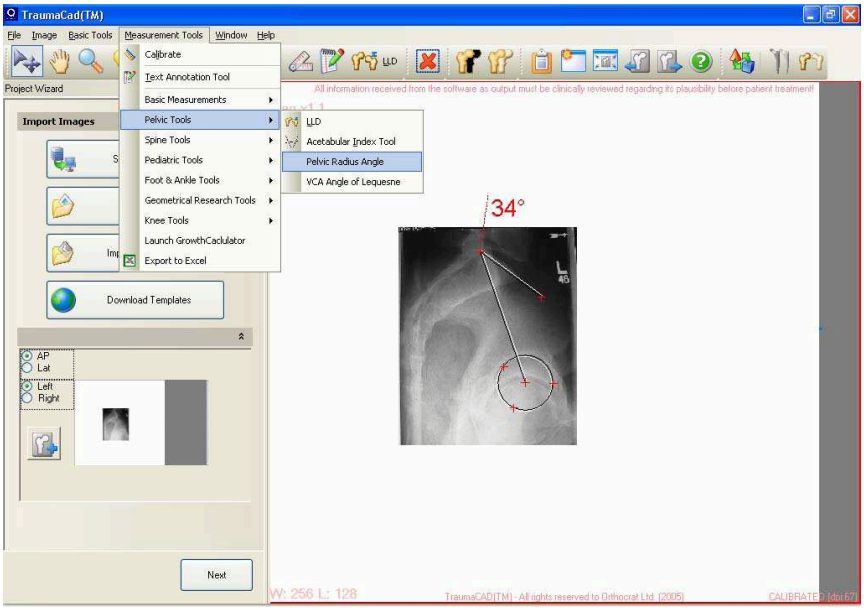
- The femoral stem angle should be determined for the specific stem that was used.
- The circle should be adjusted to the implanted head.
- Next two points should be adjusted to the implanted femoral neck.
- Next two sets of points should be adjusted to the implanted femoral stem.
- The calculated angle is the Ante/Retro version of the femoral stem (only when the thigh is at neutral rotation).



Pelvic Tools

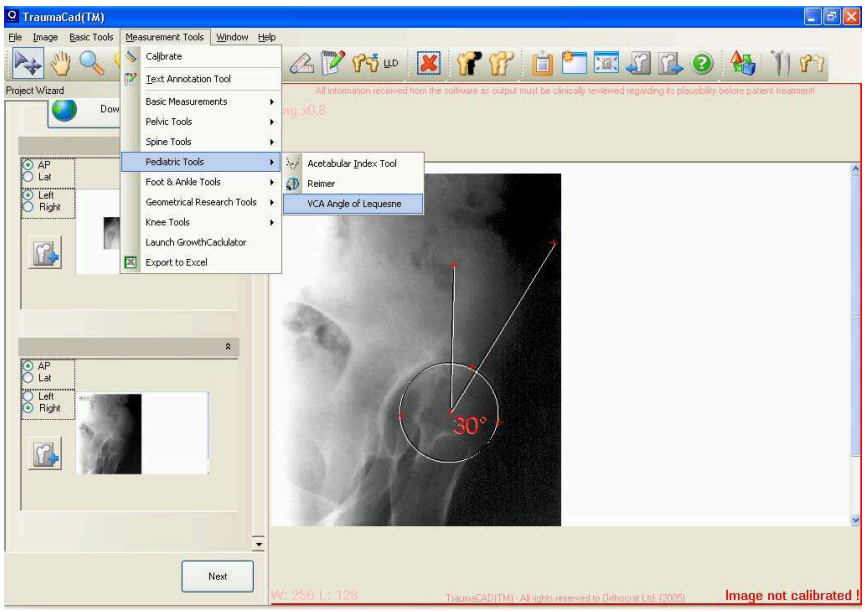
Pelvic Radius Angle

This tool measures the angle substanded by a line from the center of the femoral head to the posterior superior corner of S1 and a line drawn along the sacral end plate.



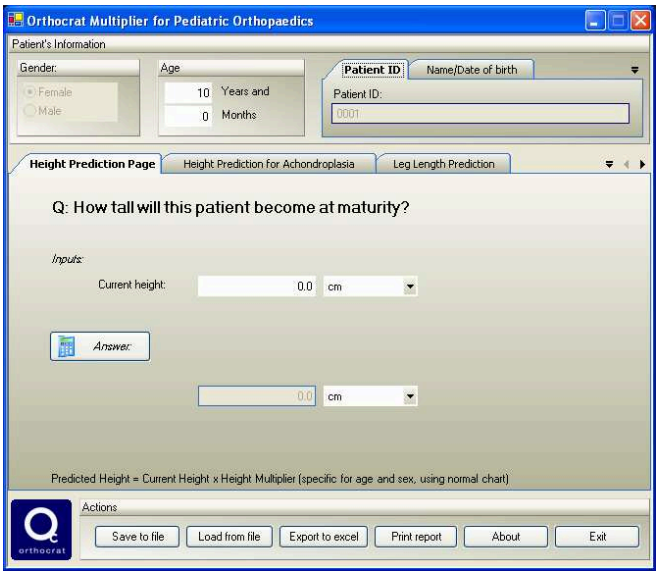
VCA Angle of Luquesne

This tool defines a vertical line passing through the center of the femoral head and a line joining the center of the femoral head and the anterior point of the Acetabular roof at the false profile view.



Growth Calculator

You can select the **Launch Growth Calculator** option from the *Measurements Tools* menu, to display the following window.



Each tab of this window provides different options for predicting the growth of a particular anatomy in pediatric orthopedics, as follows:

Height Prediction Page

Purpose: Predicts the height of this patient at maturity.

Formula: Predicted Height = Current Height x Height Multiplier (specific for age and sex, using a normal chart)

Leg Length Prediction Page

Purpose: Predicts leg length at maturity.

Formula: Predicted length at maturity = Current Length x Multiplier (specific for age and sex, using a lower limb chart)

Growth remaining = Current length - predicted length

Arm Length Prediction Page

Purpose: Predicts the length of an arm at maturity.

Formula: Predicted length at maturity = Current Length x Multiplier (specific for age and sex)

Growth remaining = Current length - predicted length

Leg Length Discrepancy Prediction - Congenital Page

Purpose: Predicts the leg length discrepancy at maturity for this patient with congenital LLD. (Congenital = Congenital femoral deficiency, fibular hemimelia, tibial hemimelia, hemihypertrophy, hemiatrophy, posteromedial bow of tibia)

Formula: Predicted length discrepancy at maturity = Current Length Discrepancy x Multiplier (specific for age and sex, using a lower limb chart)

Leg Length Discrepancy Prediction - Developmental Page

Purpose: Predicts the leg length discrepancy at maturity for this patient with developmental LLD. (Developmental = Ollier's, polio, growth arrest, also works for congenital discrepancies after lengthening)

Formulas:

Predicted length discrepancy at maturity = current difference + [1- (short leg current – short leg previous)/(long leg current – long leg previous)] x Long leg current (Multiplier (specific for age and sex using a lower limb chart)-1)

Inhibition = 1- (short leg current – short leg previous)/(long leg current – long leg previous)

Arm Length Discrepancy Prediction - Congenital Page

Purpose: Predicts arm length discrepancy at maturity for this patient with congenital LLD. (Congenital = hemihypertrophy, hemiatrophy)

Formula: Predicted length discrepancy at maturity = Current Length Discrepancy x Multiplier (specific for age and sex, using an upper limb chart)

Arm Length Discrepancy Prediction - Developmental Page

Purpose: Predicts arm length discrepancy at maturity for this patient with developmental LLD? [Developmental = Ollier's, polio, growth arrest, also works for congenital discrepancies after lengthening]

Formulas:

Predicted length discrepancy at maturity = current difference + [1- (short arm current – short arm previous)/(long arm current – long arm previous)] x Long arm current (Multiplier (specific for age and sex using upper limb chart)-1)

Inhibition = 1- (short arm current – short arm previous)/(long arm current – long arm previous)

Timing of Epiphyseodesis at the Knee Page

Purpose: Suggests the timing for epiphyseodesis around the knee of a long limb to equalize the limb length discrepancy at maturity.

Formulas:

Multiplier at correct age for epiphyseodesis = [current long leg length x current multiplier specific for age and sex using lower limb chart] / (current long leg length x current multiplier specific for age and sex using lower limb chart) - desired correction / kappa

Kappa should be calculated for 3 scenarios: distal femur = 0.71, Proximal tibia = 0.57, Both distal femur and prox. tibia = 0.67

The resultant Multiplier at age correct for epiphyseodesis must be "translated" back to a chronologic age using the lower extremity Multiplier chart specific for age and sex

Timing of Stapling for Hemi-epiphyseodesis Page

Purpose: Suggests the timing for hemi-epiphyseodesis around the knee to correct angular deformities, if the staple will not be removed.

Formulas:

Multiplier at correct age for hemi-epiphyseodesis = [current bone length x current multiplier specific for age and sex using lower limb chart] / ([current bone length x current multiplier specific for age and sex using lower limb chart] – [(width of the growth plate x desired correction/57)/ kappa]

Kappa should be calculated for one of two scenarios: distal femur = 0.71, proximal tibia = 0.57

The resultant Multiplier at age correct for hemi-epiphyseodesis must be "translated" back to a chronologic age using the lower extremity Multiplier chart specific for age and sex.

Timing of Staple Removal for Hemi-epiphyseodesis Page

Purpose: Suggests the timing for removing a staple inserted for hemi-epiphyseodesis around the knee to correct angular deformities, assuming that the stapling was done well prior to skeletal maturity.

Formulas:

Multiplier at correct age for removal of hemi-epiphyseodesis staple = [current bone length x current multiplier specific for age and sex using lower limb chart] / ([current bone leg length + [(width of the growth plate x desired correction/57)/ kappa]

Kappa should be calculated for one of two scenarios: distal femur = 0.71, Proximal tibia = 0.57

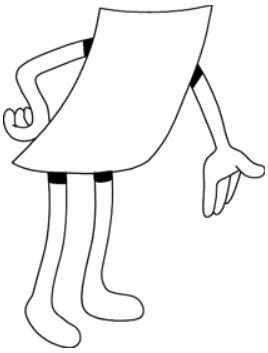
The resultant Multiplier at age for removal of hemi-epiphyseodesis staple must be "translated" back to a chronologic age using the lower extremity Multiplier chart specific for age and sex

CDC Growth Charts

The growth charts consist of a series of percentile curves that illustrate the distribution of selected body measurements in children in the United States. The 1977 growth charts were developed by the National Center for Health Statistics (NCHS) as a clinical tool for health professionals to determine if the growth of a child is adequate. The 1977 charts were also adopted by the World Health Organization for international use.

When the 1977 NCHS growth charts were first developed, NCHS recommended that they be revised periodically as necessary. With more recent and comprehensive national data now available, along with improved statistical procedures, the 1977 growth charts have been revised and updated to make them a more valuable clinical tool for health professionals.

The 2000 CDC growth charts represent the revised version of the 1977 NCHS growth charts. Most of the data used to construct these charts come from the National Health and Nutrition Examination Survey (NHANES), which has periodically collected height, weight and other health information about the American population since the early 1960's.



Chapter 5

Limb Alignment Analysis

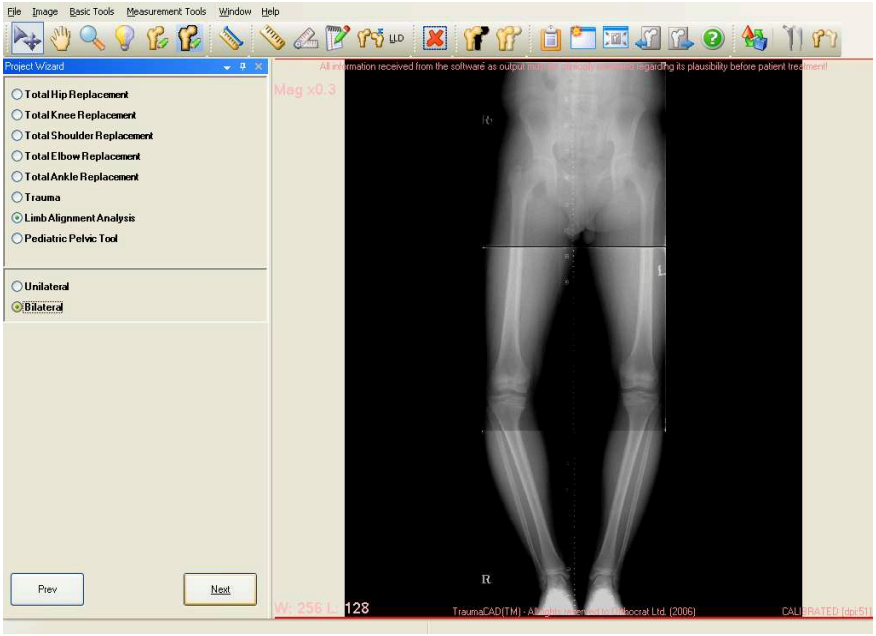
TraumaCad enables orthopedic surgeons to take anatomical measurements, compare them to normative standards and simulate corrective procedures. Easy-to-use wizards help surgeons produce a wide range of anatomical measurements. Each measurement is automatically compared to the normal parameters published in the literature and to the contralateral limb, providing instant evaluations of patient anatomy. Measurements and evaluations integrate into patient files for an easy transition to digital radiology.

To perform limb alignment analysis are as follows:

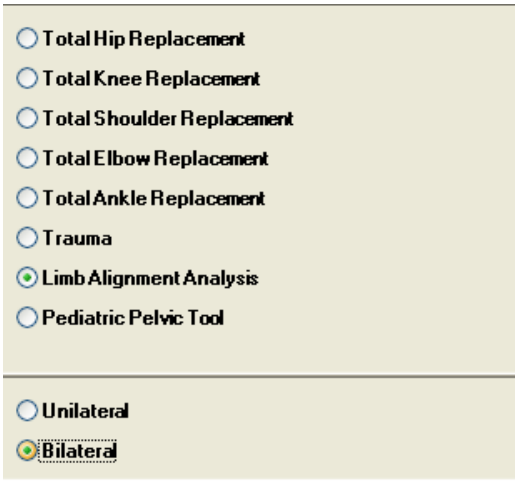
1. Select **Limb Alignment Analysis.**
3. Use the wizard to mark anatomical points on the image for limb alignment analysis, as described in page 2.
4. You can simulate osteotomies and implant fixation, as described in page 3.
3. You have the option to use TraumaCad's comprehensive growth calculator tool, as described in the ***Growth Calculator*** section on page 83 of the user manual.
4. Generate a report including textural information and transfer it to the OR, as described in the *Generate Reports* section on page 65 of the user manual.
5. Commit the image back to the PACS system, if required for future reference.

Marking Anatomical Points

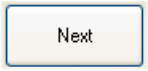
Select the **Limb Alignment Analysis** surgical procedure in the following window:



For an AP image, specify whether you want to measure unilaterally or bilaterally by selecting the appropriate radio button.



Bilateral

Click 

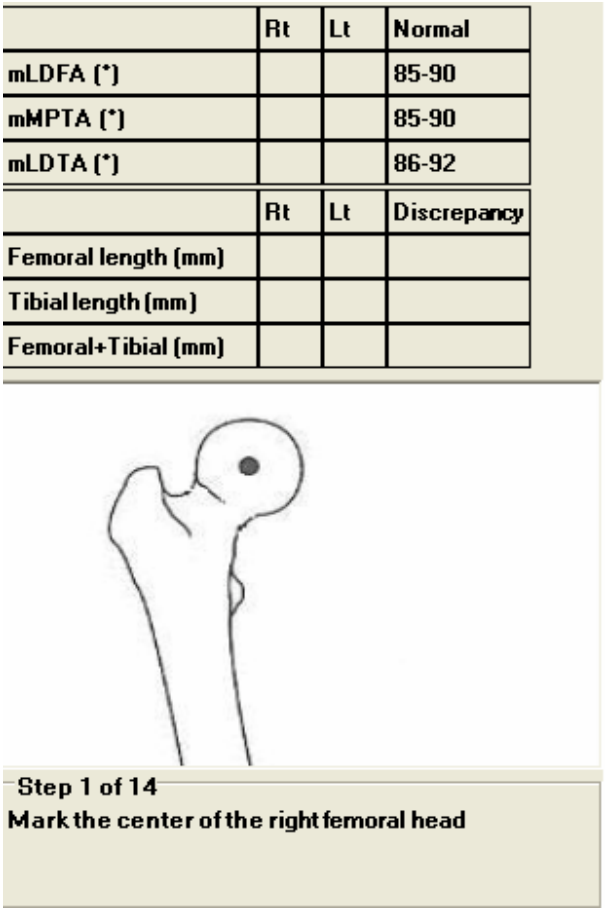
to display the following for the bilateral measurements:

mLDFA – mechanical Lateral Distal Femoral Angle.

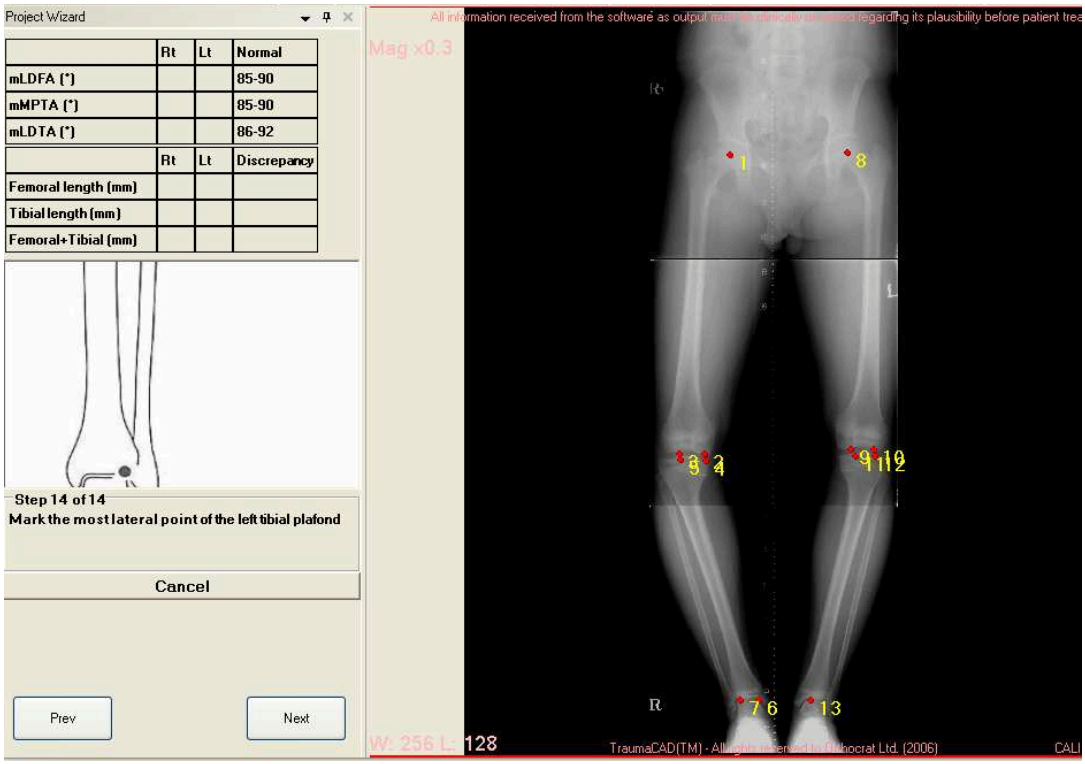
mMPTA – mechanical Medial Proximal Tibial Angle.

mLDTA – mechanical Lateral Distal Tibial Angle.

A wizard is displayed on the left of the image which guides you through the process of identifying anatomical markers by clicking on them in the image.

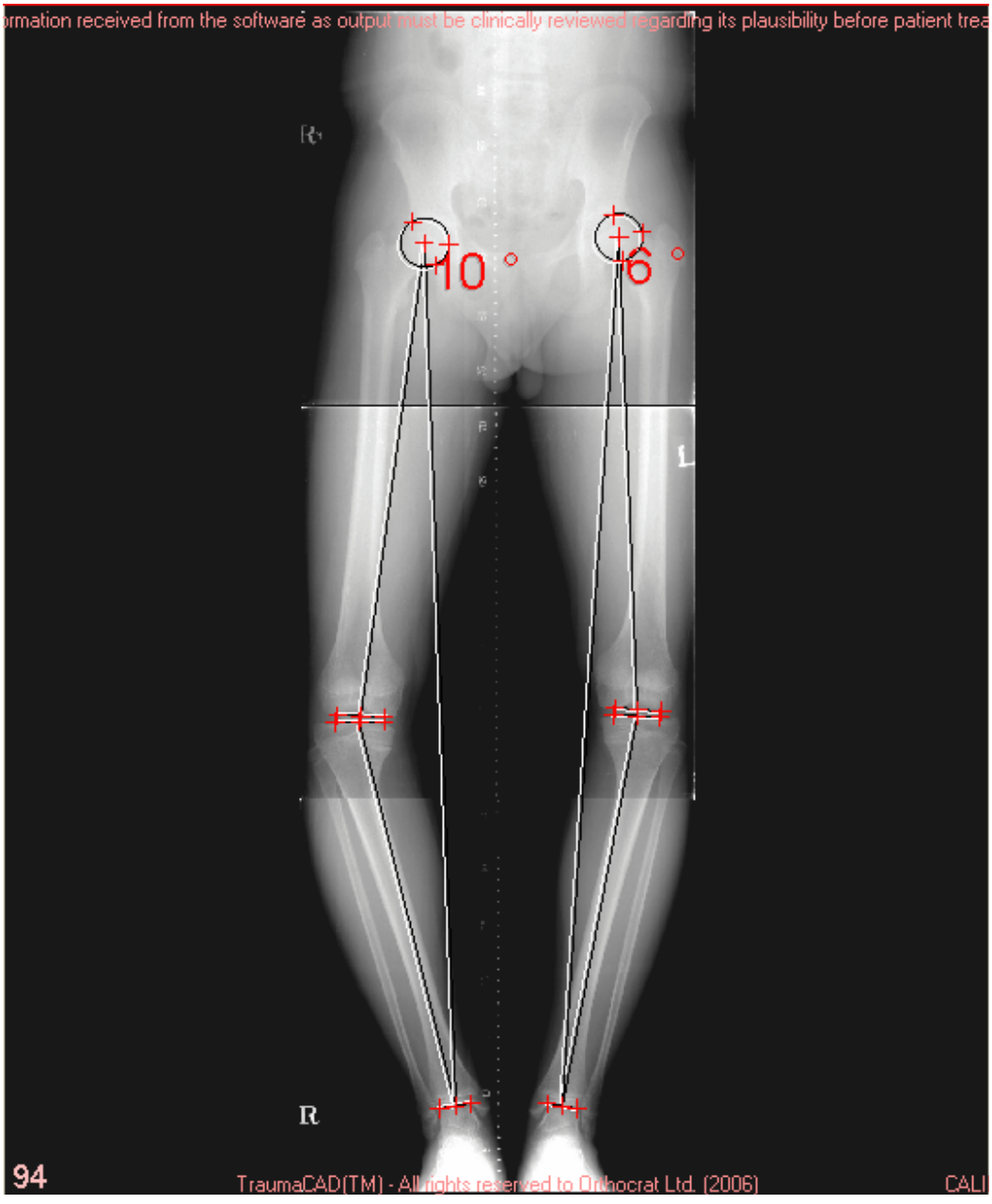


The following shows an example of the image after the thirteenth point has been marked:



Once you mark the fourteenth point according to the instructions you will be asked to adjust the marked points.

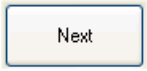
The next image will be displayed:



The Anatomical measurements are shown in the top left corner of the window, right, left, and normal for angles, or discrepancy for bone and limb length.

	Rt	Lt	Normal
mLDFA (°)	95	97	85-90
mMPTA (°)	76	82	85-90
mLDTA (°)	85	88	86-92
	Rt	Lt	Discrepancy
Femoral length (mm)	449	444	5
Tibial length (mm)	354	356	2
Femoral+Tibial (mm)	803	800	3

Unilateral

Click 

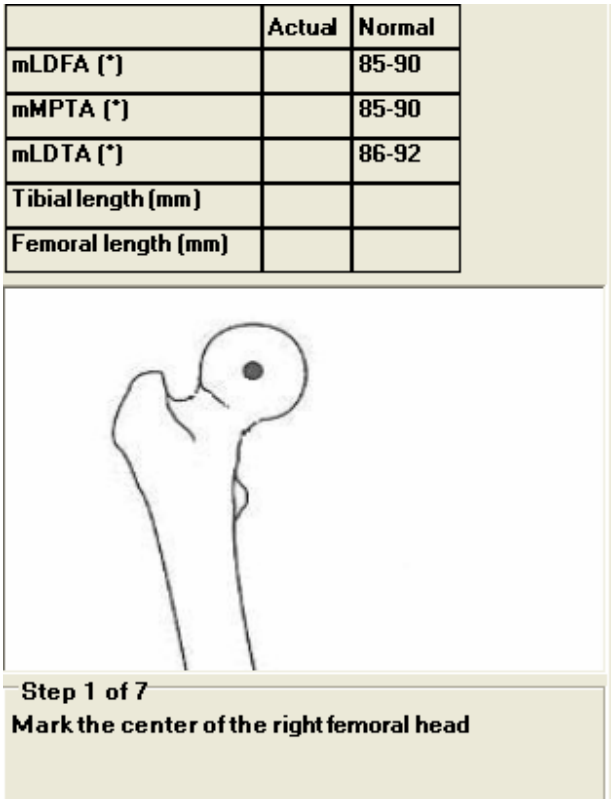
to display the following measurements:

mLDFA – mechanical Lateral Distal Femoral Angle.

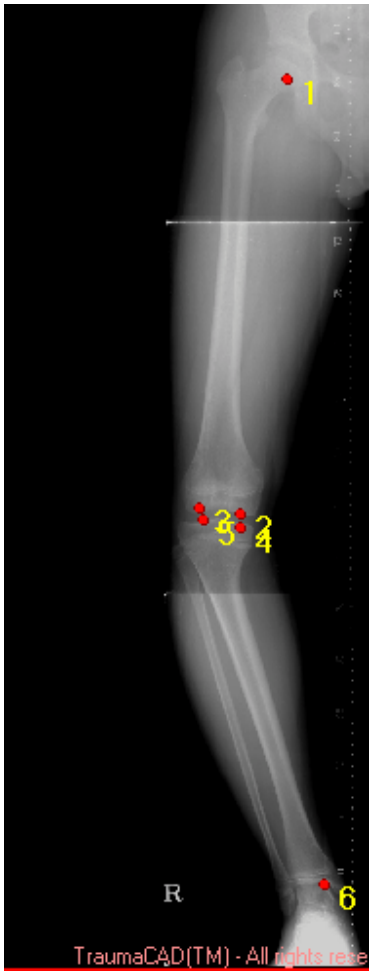
mMPTA – mechanical Medial Proximal Tibial Angle.

mLDTA- mechanical Lateral Distal Tibial Angle.

A wizard is displayed on the left which guides you through the process of identifying anatomical markers by clicking on them in the image.

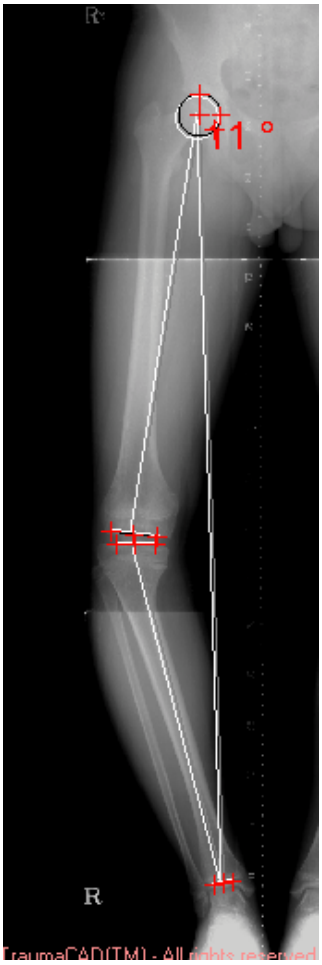


The following shows an example of the image after the sixth point has been marked:



Once you mark the seventh point according to the instructions you will be asked to adjust the marked points.

The next image will be displayed:

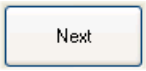


The Anatomical measurements are shown in the top left corner of the window.

	Actual	Normal
mLDFA (°)	92	85-90
mMPTA (°)	75	85-90
mLDTA (°)	85	86-92
Tibial length (mm)	350	
Femoral length (mm)	446	

Lateral

For a Lateral image, there are only unilateral measurements:

Click 

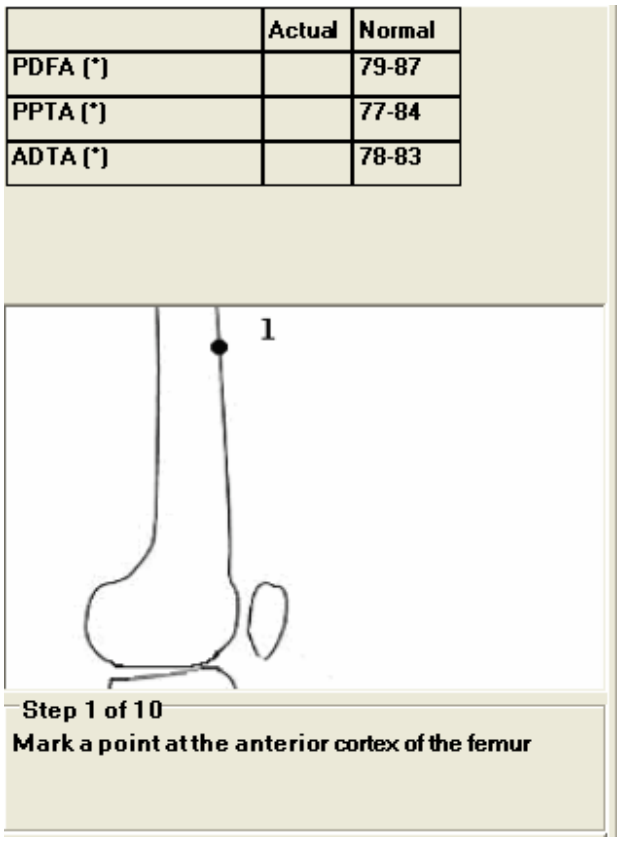
to display the following lateral measurements:

aPDFA – anatomical Posterior Distal Femoral Angle.

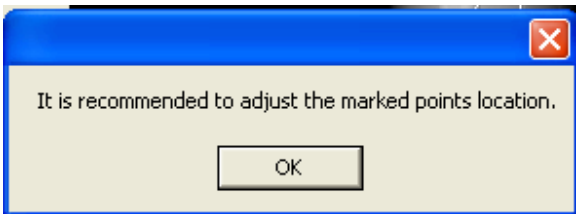
aPPTA – anatomical Posterior Proximal Tibial Angle.

aADTA- anatomical Anterior Distal Tibial Angle.

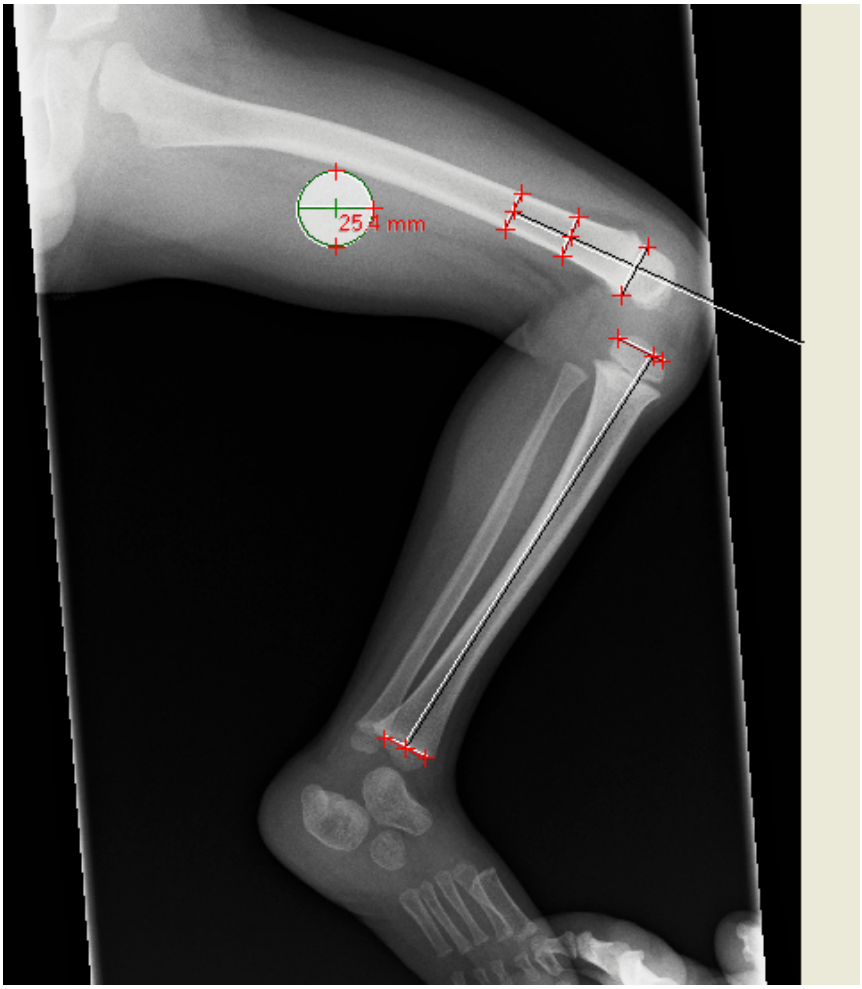
A wizard is displayed on the left which guides you through the process of identifying anatomical markers by clicking on them in the image.



Once you mark the tenth point according to the instructions you will be asked to adjust the marked points.



The next image will be displayed:



The Anatomical measurements are shown in the top left corner of the window.

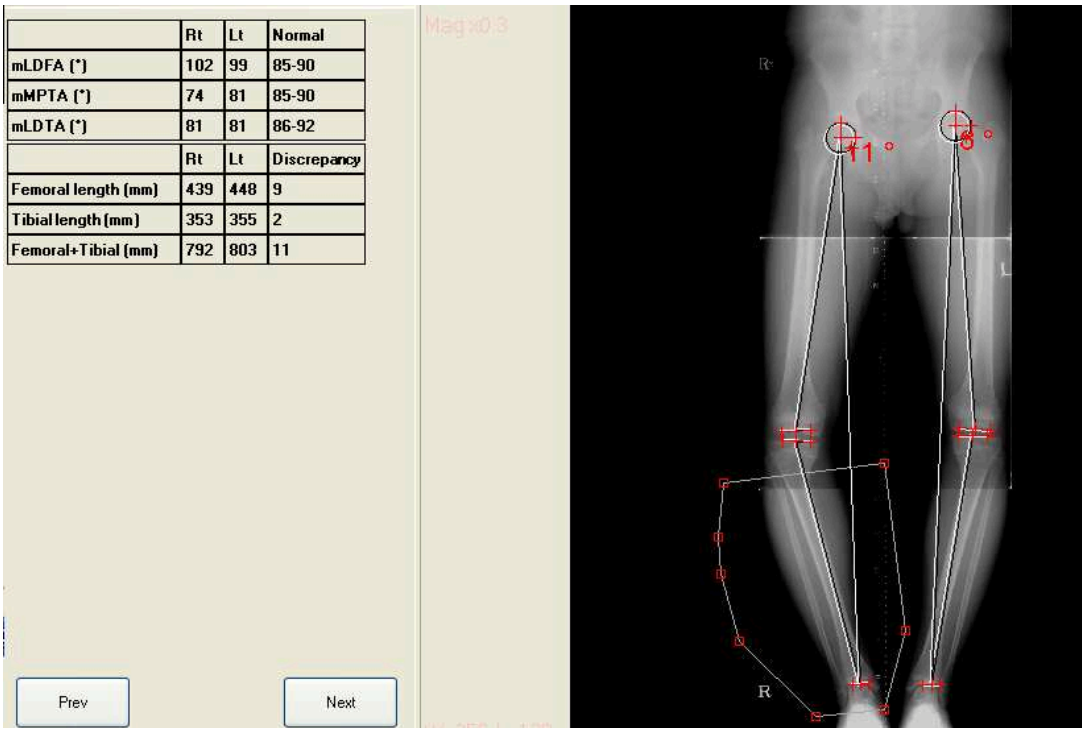
	Actual	Normal
PDFA (°)	74	79-87
PPTA (°)	83	77-84
ADTA (°)	85	78-83

Osteotomies Simulation

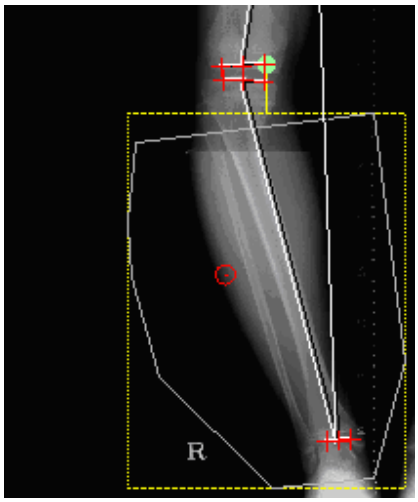
After completing the limb alignment measurements, a simulation of osteotomies and implant selection can be done.

Define the distal fragment using the “Define Fragments"  or "Lasso Fragments"  tools.

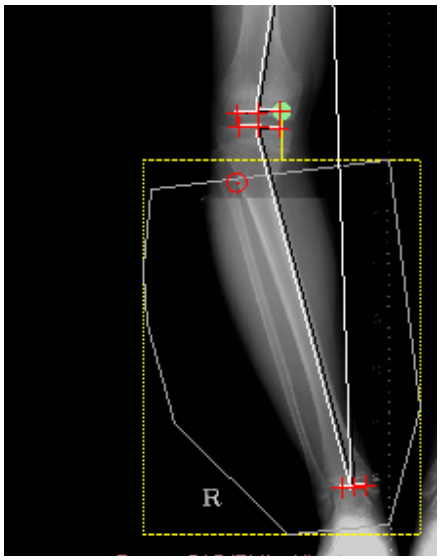
Cut the distal fragment using the "Cut Fragments"  tool.



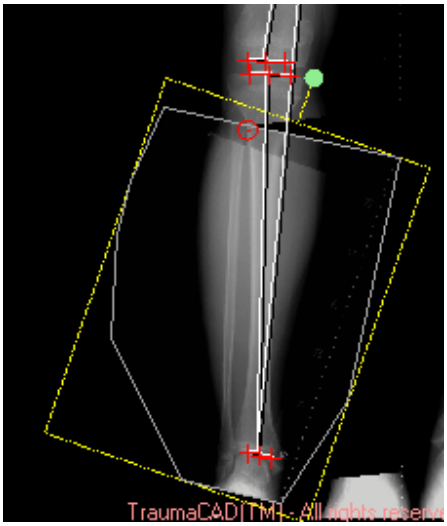
	Rt	Lt	Normal
mLDFA (°)	102	99	85-90
mMPTA (°)	74	81	85-90
mLDTA (°)	81	81	86-92
	Rt	Lt	Discrepancy
Femoral length (mm)	439	448	9
Tibial length (mm)	353	355	2
Femoral+Tibial (mm)	792	803	11



Drag the red circle to the desired CORA (Center Of Rotation of the Angulation). The CORA can be measured by using the knee tools of the measurements tools on the toolbar, or manually for simple deformities.



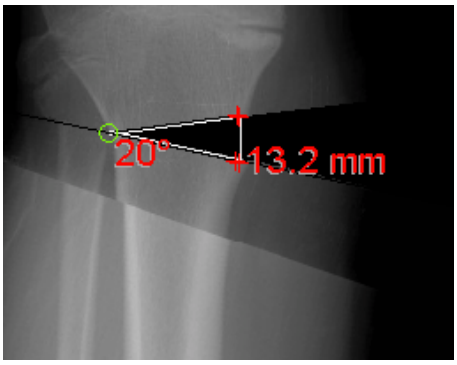
Simulation of the osteotomies can be done now by moving the green dot or by clicking on the Ctrl button while moving the distal fragment with the mouse.



The projected post operative measurements are displayed in the table.

	Rt	Lt	Normal
mLDFA (°)	97	99	85-90
mMPTA (°)	90	81	85-90
mLDTA (°)	78	81	86-92
	Rt	Lt	Discrepancy
Femoral length (mm)	441	448	7
Tibial length (mm)	362	355	7
Femoral+Tibial (mm)	803	803	0

Now you can zoom in and measure the osteotomy's parameters.



You have the option to choose implants as shown in the ***Selecting an Implant*** section.

You have the option to use TraumaCad's comprehensive growth calculator tool, as described in the ***Growth Calculator*** section on page 83 of the user manual.

Generate a report including textural information and transfer it to the OR, as described in the *Generate Reports* section on page 65 of the user manual.

Commit the image back to the PACS system, if required for future reference.